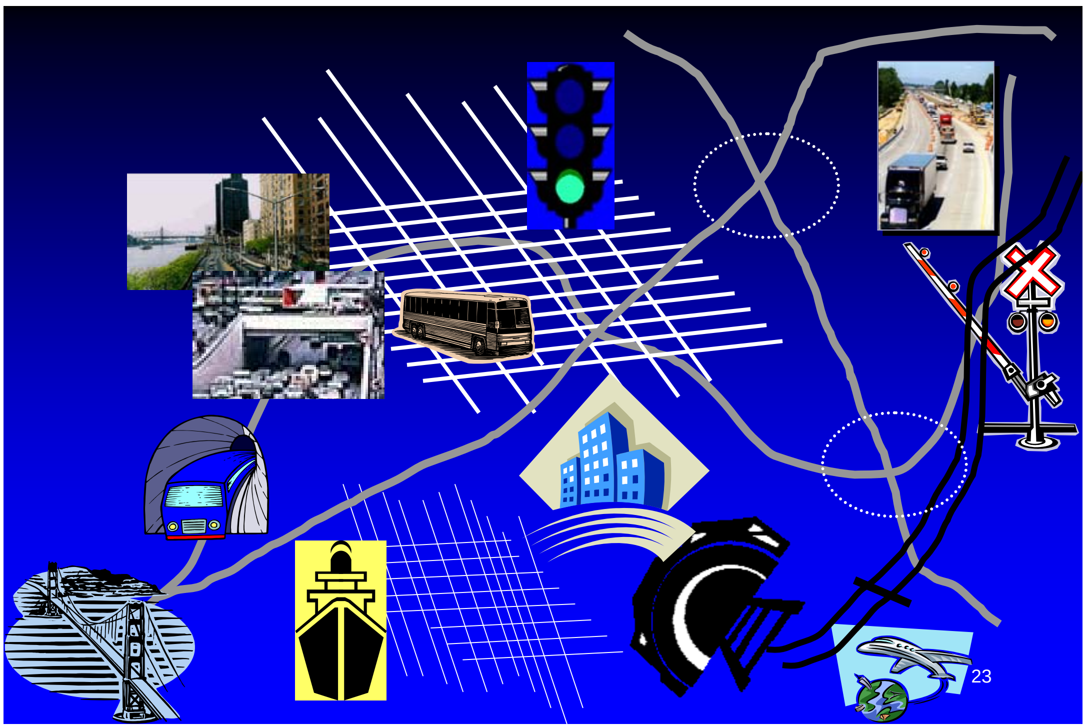
Strategic Intelligent Transportation Systems (ITS) Deployment Plan for New York City

FINAL REPORT



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List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ATMS	Advanced Traffic Management System
APTS	Advanced Public Transportation System
ATIS	Advanced Traveler Information System
CBD	Central Business Districts
CCTV	Closed Circuit TV
CIDNY	Coordinated ITS Deployments in New York
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Sign (same as VMS-Variable Message Sign)
EM	Emergency Management Subsystem
ERC	Emergency Response Center (NYCDOT)
FHWA	Federal Highway Administration
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
ITMS	Integrated Transportation Management System
JTOC	Joint Traffic Operation Center (NYSDOT Region-11/NYCDOT/NYPD)
MC	Maintenance and Construction
NTCIP	National Transportation Communications for ITS Protocol
NYCDOT	New York City Department of Transportation
NYCSRA	New York City Sub-Regional Architecture
NYPD	New York City Police Department
NYSDOT	New York State Department of Transportation
OEM	Office of Emergency Management (NYC)
OER	Office of Emergency Response (NYCDOT)
SEP	Systems Engineering Process
SOPs	Standard Operating Procedures
TMC	Traffic Management Center
TOC	Traffic Operation Center
TIM	Traffic Incident Management
UITSC	Urban ITS Center (Polytechnic University)

Strategic Intelligent Transportation Systems (ITS) Deployment Plan for New York City

Executive Summary

I. Introduction to Intelligent Transportation Systems (ITS)

Intelligent Transportation Systems (ITS) are often introduced as a tool box to manage urban congestion and balanced travel demands by improving operational capabilities, transportation efficiency and safety. Over the past decades, New York City has introduced elements of ITS on its streets, bridges, tunnels and highway infrastructure. The operational capabilities of ITS for traffic management and emergency management have been amply demonstrated during the recent emergencies. However, the experiences have shown that the local agencies need to unite for common purpose and greater benefits from ITS deployments in the City. The local agencies have realized that without integration of systems and devices, full benefits of ITS investments cannot be realized. Operational efficiency and improved capabilities through integration are needed to manage congestion in New York City.

ITS refers to the application of data processing, data communications, and systems engineering methodologies with the purpose of improved management, safety and efficiency of the surface and public transportation network. These ITS technological and management advances come from different disciplines and if integrated can address the overall mobility needs of a region, the travel requirements of transportation network users, and the development, operation, management and maintenance needs of the transportation system providers, both public and private.

ITS provide a means to address current urban problems, as well as to anticipate and address future demand through a coordinated, intermodal approach to transportation. The application allows the NYCDOT and other agencies to use modern technologies to better monitor their systems, providing the agencies with more accurate information to make more informed decisions on safely operating their systems. ITS also allows agencies to distribute this information to other agencies and to the public, so each can make more informed transportation decisions. (Ref.2)

The New York City region has invested significant resources on ITS deployments in the past decades. For example, NYCDOT has built the Vehicular Traffic Control system (VTCS) and other supporting systems such as Computerized Area Tracking System (CATS), and has gained significant experience and benefits from such investments. Today, NYCDOT has reached a point where all pieces of ITS must be brought together to improve operational efficiency and capabilities needed for better coordination among agencies within the City and in the region.

The roadmap shown below outlines necessary steps to achieve the above stated ITS objectives.

II. The Roadmap to ITS Deployment

The *Strategic Intelligent Transportation Systems (ITS) Deployment Plan for New York City* (Strategic Plan) initiated by the Department of the Transportation (NYCDOT), provides guidance on the following three key steps required for ITS deployment:

1. **NYCDOT ITS Implementation Strategy:** Outlines steps NYCDOT must take to implement large-scale ITS functions and services in five boroughs.
2. **NYCDOT Five-Year ITS Deployment Plan:** Provides an overall view of various ITS projects at planning and deployment stage.
3. **NYC Sub-Regional ITS Architecture (NYCSRA):** This product has been developed for all local agencies and provides a set of NYCDOT-specific market packages available for deployment. It also provides pathway to other agencies and functions for interconnectivity among systems and agencies. Beginning in 2005, the deployment of NYCSRA in all federally funded ITS projects is mandatory in New York City.

The roadmap elements are shown in Figure-1. The top box refers to the recently completed NYCSRA process and the bottom box provides a recommended implementation strategy. Both pieces are needed to complete the deployment process.

NYCSRA Development Process (Completed)

User Services
(See Chapter 4)

New York City Sub-Regional Architecture (NYCSRA)
(Refer to Appendix-A for Full Text)

Local Stakeholders
NYCDOT
NYSDOT
MTA
PA of NY/NJ
Other agencies

Market Packages for Each Local Agency Developed by Functional Areas
ATMS-Advanced Traffic Management System
ATIS-Advanced Traveler Information System
APTS-Advanced Public Transportation System
CVO-Commercial Vehicle Operations
EM-Emergency Management
MC- Maintenance and Construction

NYCDOT Market Packages Available for Deployment

Available Market Packages	**Transportation Service Provided**
APTS 1,2,4,5,6,8	Transit management
ATIS 2	**Travel management (Priority)**
ATMS01, 08,13,16,18,20	**Traffic management (Priority)**
CVO04	Commercial vehicles
EM2	Emergency management
MC01 and MC03-10	Maintenance/weather system

Note: Some ITS projects may require multiple market packages from above list

Implementation Strategy Elements (Proposed in this Plan)

Utilize Systems Engineering Process (SEP) for Project Development

Utilize Required NYCSRA Market Packages (shown in box above)

Implement Communications Infrastructure (Fiber, Wireless Network etc.)

Provide Integration of Functions, Devices, and Sub-systems, Use ITS Standards

Provide ITS Research, Training & Education Support (UITSC)

Figure-1 Roadmap for the NYCDOT ITS Deployment

1. NYCDOT ITS Implementation Strategy

The NYCDOT has come to a pivotal point where functionality of individual ITS projects must be integrated to provide capabilities for coordination, information exchange among agencies, and improving operational efficiency.

As shown in Figure-1, the local agencies have recently (2004) developed the NYC Sub-Regional ITS Architecture (NYCSRA). The main focus of the NYCSRA is the development of agency specific market packages as shown in Figure-1. These needs are matched by user services and functional areas, and translated into customized market packages for each agency. These packages are the basis for ITS deployment in ITS in the City.

Without an implementation strategy, it will be difficult to fulfill the above ITS deployment objectives. Realizing this need, this Strategic Plan has developed an implementation strategy based on the following components:

1. NYC Sub-Regional ITS Architecture/ITS Standards
2. Communication Backbone
3. Integration
4. Interoperability
5. ITS Research, Training, and Education Support by UITSC
6. Systems Engineering Process (SEP)

This implementation strategy is based on the “top down” approach (NYCDOT) management) which sets ITS priorities and policies, and the “bottom up” approach (operational requirements) that is needed to create communications infrastructure, system functions, and staffing that will support operational needs.

When completed, these components will help NYCDOT achieve system capabilities needed for regional and local coordination among agencies, and in managing traffic and travel information at peak operational efficiency. These components are discussed in details in next chapters.

2. The NYCDOT Five Year ITS Deployment Plan

The NYCDOT has undertaken a significant number of ITS projects which are either in progress or at substantial planning stage. As shown in Table-1, these selected projects will allow the NYCDOT to expand ITS capabilities in five boroughs and contribute towards an integrated Transportation Management System (ITMS). These strategic investments in ITS projects will serve NYCDOT's internal operational and coordination needs, and make it possible to communicate, coordinate, and exchange information with other local and regional agency systems in New York City (City). With these investments and integration, NYCDOT's capabilities of ITS for operational efficiency will be greatly enhanced.

Table-1 below identifies ITS projects at the planning and deployment stages under logically arranged categories.

Table-1 The NYCDOT Five Year ITS Deployment Plan (2005-2009)

#	Title	Year	Est.Cost	Status
	Systems Engineering Support Services			
1	Engineering Design & Inspection for an ITS Related and Planning , Contract-A	2005	$5.0 m	In progress RFP selection
2	Engineering Design & Inspection for an ITS Related and Planning , Contract-B	2005	5.0	In progress RFP selection
3	Systems Engineering Agreement for TOPICS-IV.	2005	-	Ongoing
	ITS Systems Center to Center Integration			
4	New York City Multi-agency Integrated Transportation Management System (ITMS)-Randall Is.TMC. a. Design phase-Functional Requirements b. Hardware/Software Integration, TMC to TMC	2005	0.9 1.8	Planning/Design Priority Project
	TOPICS-IV Traffic Signals Computerization, Brooklyn/Bronx			
5	Communications-Wireless Network	2005-06	8.0	Planning/RFP
6	Field Construction (Furnish & Install)	2006	8.0	Planning
	Procurement of Actuated Signals Traffic Controllers (ASTC)			
7	Actuated Signals Traffic Controllers (ASTC) Procurement Phase-1 1000 units	2002-2005	5.5	In progress Priority project
8	ASTC Procurement Phase-2, 5000 units 2200 for TOPICS-IV Brooklyn/Bronx 2800 for Non-VTCS	2005-2008	30.0	Planning
9	Battery Back-Up System for 1000 signals	2005	2.0	In progress
10	Adaptive Traffic Control System (S.I. College)	2006	-	Conceptual
	Advanced Traffic Management Systems Expansion			
11	Local Streets Network and Incident Management System	2006	12.6	Planning
12	FDR Drive ITS Elements (CCTV, DMS, and Detection).	2005-06	4.0	Planning
13	Fiber Network for Brooklyn, Bronx and Queens	2006-09	4.6	Planning
14	Lower Manhattan ITS	2005	-	Planning
15	Williamsburg Bridge ITS Elements	2004	-	Completed
16	Queens Borough Bridge ITS Elements	2004	-	Completed
17	Manhattan Bridge ITS Elements	2004	-	Completed
18	Third Avenue Bridge ITS Elements	2006	-	Planning
	Advanced Traffic Management Systems for New York City Expressways (CMAQ Funding)			
19	Implementation of ITS System Along New England Thruway (I-95) (Pelham Pkwy.-City line)	2007	2.45	Programmed
20	Jackie Robinson Parkway -Queens	2006	2.20	Programmed
21	Cross Island Parkway (Whitestone Pkwy. to South. State)	2007	1.35	Programmed
22	Henry Hudson Parkway (GWB-City line)	2007	3.20	Programmed
23	Belt Way, Brooklyn-Queens (65 St. to South. State Pkwy.	2006-09	8.00	Programmed
24	Korean War Memorial Veteran Parkway, Staten Island	2008	2.50	Programmed
	Advanced Public Transportation System (APTS)			
25	Traffic Signal Priority Control for Transit Vehicles-SI	2005	0.70	In Progress
	Advanced Traveler Information System (ATIS)			
26	Advanced Traveler Information System –Citywide	2006	4.00	Planning
	Web-based Traveler Information ATIS			
27	Vehicle-flow rates, Maps, Sensor for Travel time	2006	-	Conceptual
	Video Based-Radiation Detection System for Evacuation			
28	Commercial-Truck Detection System for Radio Activity	2006	-	Conceptual

3. New York City Sub-Regional ITS Architecture (NYCSRA)

In 2004, a cooperative effort of local agencies and FHWA have produced an overall ITS framework called the New York City Sub-Regional ITS Architecture (NYCSRA). This ITS framework will allow all agencies to implement their own ITS projects in several functional areas, such as incident management, surface traffic control and freeway management. This effort has developed a set of market packages suitable for functional applications for all local agencies.

There are three key reasons why the NYCDOT is required to consider the deployment of NYCSRA in current and future projects:

1. **Funding:** To continue qualifying for federal funding for ITS projects, NYCDOT must begin to implement the NYCSRA at project-levels in 2005 under FHWA Rule 940.
2. **Interconnectivity**: For effective traffic management in the City, agencies must coordinate and communicate with each other, and system to system, for real-time information exchange. NYCSRA will provide that interconnectivity through interfaces.
3. **Uniformity in Implementation**: The NYCSRA coupled with the NYCDOT internal measures will ensure that engineering consultants will implement and develop market packages with uniformity and consistency.

For the NYCDOT, implementing the NYCSRA is a critical step since a significant number of projects are underway and only the NYCSRA can tie them together. While individual ITS projects may provide NYCDOT some benefits, the real benefits will only result if functions, devices, systems, and institutional operating procedures are all considered and implemented to operate with each other in harmony. This is a major challenge for the NYCDOT. Therefore, the NYCSRA must be consulted and care must be taken in selecting appropriate market packages (specific to NYCDOT) to achieve the following ITS objectives:

- Improvements in operational efficiency.
- Ability to communicate and coordinate operations both at the local and regional level.
- Ability to exchange information within the agency and with other partners in the region.

- An integrated transportation management system (ITMS)
- Ability to enhance transportation security and emergency management (i.e. The Disaster Recovery and Evacuation (DRE) market package in version 5.1 of the National ITS Architecture for emergency management. This version has yet to be included in the NYCSRA at this time.

The NYCDOT should direct all Systems Engineering managers (hired consultants or in-house staff) to select the market packages based on the desired transportation service and build the software that will create the interfaces for the data flows indicated in the customized market package diagrams. This includes the deployment of ITS standards and protocols consistent with the requirements of the NYCSRA.

III. Document Organization

This document addresses the following NYCDOT needs:

- Specific ITS requirements identified by users.
- A list of ITS deployment projects organized under selected categories.
- An implementation strategy to guide deployment process.

The following chapters are organized with these above needs in mind.

Chapter 1 Introduction

Provides introduction to the strategic deployment plan; the process used to develop this plan, and the intended audience of this plan. It also states why NYCDOT should have a single living document to guide the ITS deployment process for the next five years.

Chapter 2 Functional Area Requirements

In this chapter, strategic issues presented by the NYCDOT staff are discussed. Eleven high-level functional areas for operational improvements are identified by the users during the preparation of this plan. These functional areas will provide transportation services needed by the NYCDOT.

Chapter 3 Implementation Strategy

NYCDOT needs an implementation strategy to guide each ITS project. The implementation strategy discusses six key ingredients for a successful ITS project: New York City Sub-Regional Architecture (NYCSRA), communication backbone, integration, interoperability, and training.

Chapter 4 New York City Sub-Regional ITS Architecture (NYCSRA)

This chapter states why NYCDOT must start deploying the NYCSRA and provides examples of market packages suitable for project-level deployment (Also see Appendix-A).

Chapter 5 The NYCDOT Five-Year Deployment Plan

This chapter provides a table that outlines ITS projects currently at the planning or deployment stage. This single-source of listing will provide an overall view of ITS deployment and relationship among various categories.

Chapter 6 Role of the NYCDOT Traffic Management Center (TMC)

In this chapter, current and future roles and tasks performed by the TMC in traffic management, emergency management, and local and regional coordination are covered.

Chapter 7 ITS Research, Training and Education Support

The chapter covers the ITS research and training support provided by the Urban ITS Center (UITSC) under the CIDNY contract.

Additional information related to this strategic plan is organized under following appendixes:

- Appendix-A *New York City Sub-regional ITS Architecture (NYCSRA)*
- Appendix-B 1999 *Framework for a Strategic Local Plan for New York City*
- Appendix-C *USDOT 2004 ITS Deployments Initiatives*
- Appendix-D ITS Standards and Protocols.
- Appendix-E FHWA Final Rule and FTA Final Policy on ITS Architecture and Standards
- Appendix-F SAFETEA Authorizations
- Appendix-G FHWA Current Program, December 2004.

Chapter 1 Introduction

1.0 Purpose of the Updated Strategic Plan

The purpose of this strategic plan is to provide guidance to NYCDOT on the deployment of the Intelligent Transportation Systems (ITS) in the City. The document offers an implementation strategy for the deployment process.

The NYCDOT and other local agencies in New York City have recognized the extensive operational coordination and traffic management role played by ITS during major emergencies. The experience gained during 9/11 has prepared agencies to seek further gains by improving interconnectivity through effective integration of systems, devices, and standard operation procedures.

Today, NYCDOT has assigned an operational priority on the integration of ITS functions within NYCDOT and with local and regional partners. The NYCDOT has recognized that there is a need to update the 1999 ITS Plan Elements (Ref.1) to reflect current needs, and to stress integration and deployment of the NYCSRA; a mandatory step that must be taken in 2005. This updated strategic plan incorporates current requirements for integration, deployment of additional ITS elements, and broadening of ITS applications in all five boroughs. The following 11 functional areas consolidate the current state of ITS needs at the NYCDOT.

1. Traffic Management and Operational Efficiency
2. Freeway Management Systems (FMS) Expansion
3. Congestion management in Central Business Districts (CBDs)
4. Traffic Incident Management (TIM)
5. Emergency Management
6. Travel Management
7. Information for Public
8. Transportation Security and CVO-Truck Tracking

9. Surface Public Transit Coordination
10. Traffic Management Center (TMC)
11. Local and Regional Coordination

Each functional area represents transportation services that must be considered in project level development. Based on current estimates, NYCDOT has identified at least 26 new ITS projects that collectively reflect all of the above functional areas. Some of these projects are already funded. These projects will be based on the recently completed NYCSRA.

1.1 Big Picture Considerations

ITS in general has many facets. Some professionals view ITS as technical tools, while others view visible benefits of ITS in the streets and highways and consider ITS as part of operation. Policy and funding managers take a long-term view of ITS investments and resulting benefits and operational staff may take a bottoms up approach in the management of streets and highways. Both views are to be considered from a broader and comprehensive prospective.

At the NYCDOT, the ITS focus has shifted from concepts and initial deployment of ITS elements to a large-scale expansion of ITS in its five boroughs in order to deliver an integrated system. With the advent of the NYCSRA, local agencies need to be interconnected with each other at the institutional, systems, and device level. In preparing this document, the following questions were considered:

- How can we use ITS to release congestion on major arterials? In CBDs?
- Are we looking at the whole picture or just a part of it?
- How can we inform the public, so they can make better decisions on travel?
- Estimated travel times need to be accurately calculated and transmitted.
- How can we exchange information among local agencies and improve coordinated traffic management?

1.2 A Methodology for the NYCDOT ITS Deployment

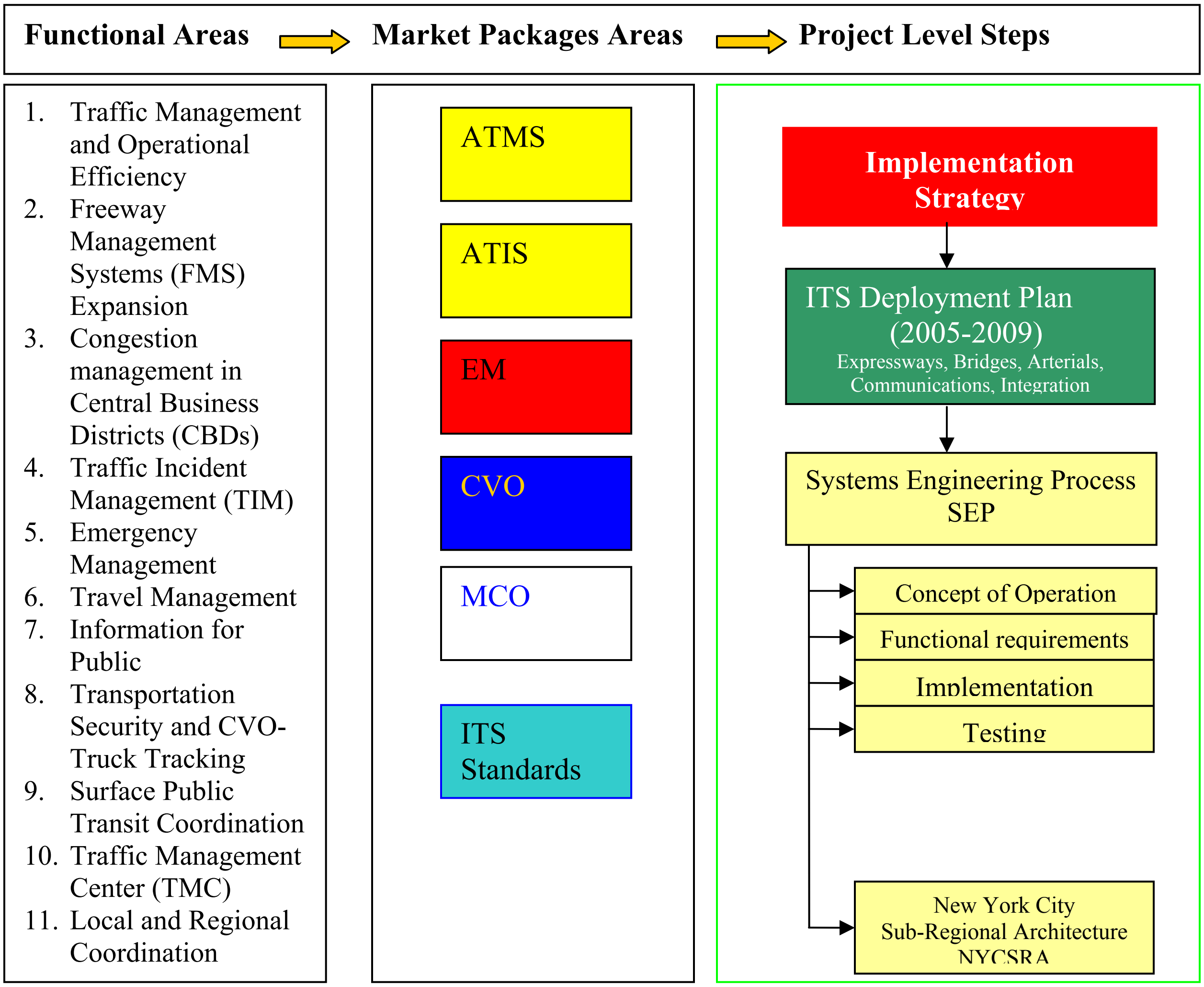

Figure-2 Methodology for NYCDOT ITS Deployment

As shown in Figure-2, the methodology for the NYCDOT ITS deployment consists of a list of user identified functional areas, architecture terminology-based market packages and specific steps necessary for project level deployment.

For example, NYCDOT (a user) has have identified traffic management and operational efficiency as key requirements, and has created several projects to support those requirements. In this example the traffic management and operational efficiency will be addressed by the ATMS market packages. As shown in Figure-2, the implementation strategy has a series of steps that must be considered by implementers. The implementers must be guided by the structured Systems Engineering Process (SEP), the recently completed NYCSRA, and NYCDOT specific market packages.

1.3 Inputs to the Document

The strategic plan preparation included a series of brainstorming meetings with the NYCDOT/NYPD staff and one to one interviews with individuals to discuss over 60 issues of interests. Table-2 shows additional documents used in the preparation of this updated Strategic Plan.

Table-2 Inputs to Strategic Plan

#	Document	Source	Contribution to this Plan
1	Project Meetings/Notes	NYCDOT/NYPD Staff Interviews	User needs were stated by staff and 11 functional areas were identified for linking ITS projects now under considerations during the interview of operational staff.
2	1999 *Framework for a Strategic Local Plan for New York City* (Appendix-A)	NYCDOT/UITSC	Allowed a quick review of the previous work for continuity and relevance of 8 ITS Plan Elements that were identified in 1999. Some elements are already deployed partially or fully.
3	*New York City Sub-regional ITS Architecture (NYCSRA)* (Appendix-B)	ConSysTech/NYCDOT	The architecture has developed NYCDOT specific market packages which are candidates for deployment. This plan is takes from NYCSRA work and develops implementation strategy needed by NYCDOT.
4	USDOT 2004 ITS Deployments Initiatives (Appendix-C)	USDOT/FHWA	USDOT outlines current thinking of the ITS areas and provides an opportunity to structure local ITS projects. It gives NYCDOT information on the national ITS priorities for deployment.
5	ITS Standards and Protocols. (Appendix-D)	ITE/AASHTO/NEMA FHWA	This plan identifies a basket of applicable ITS standards for common use and to create interoperability as required for interoperable functions and integration and interconnectivity.
6	Rule 940 (Appendix-E)	FHWA	NYCDOT largely uses federal funding for ITS projects. Beginning in 2005, to continue to qualify for federal funding for ITS projects, local agencies must incorporate NYCSRA at project-levels as stated in the document.

Note: ConSysTech has developed a draft implementation strategy for NYC Agencies at this time.

1.4 Intended Audience

This document is intended for the NYCDOT executive management and ITS and traffic engineering operational staff responsible for project development, contracts, specifications and implementation of ITS projects. The document will provide a roadmap which will delineate an understanding of the necessary steps for ITS deployment.

Chapter 2 Functional Area Requirements

2.0 Introduction to Terminologies

The following terminologies are adopted for this strategic plan:

Function: One or more coordinated processes or operations designed to achieve a particular goal.

Functional Area: Transportation service (e.g. traffic management)

Requirement: A function that must be performed by a system, together with all quantitative measures pertaining to it.

Technical Requirements: Specify the product, service, or system to be delivered according to the contract. The technical requirements include functional requirements, design constraints, and interface requirements.

User: A system operator or one who owns the system or a beneficiary of system functions (The ITS Architecture considers a traveler also as a user of ITS).

User Needs: Describe what the user of the final system desires or requires the system to do in order to provide a benefit, or to correct a current problem or to improve an operation.

User Services: Documents what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators

User Requirements: A specific functional requirement statement of what must be done to support the ITS user services.

2.1 Linkage between the Requirements Process and Deployment Process

As shown in Figure-3, a requirements process begins with identification of a functional area in which improvements or services are desired by the users, and the strategic or core functional requirements for a system (or group of equipment) in order to deliver desired functions. Local and regional coordination requirements and technical requirements are added based on local needs. The NYCDOT will need to undertake a deployment process consisting of an implementation strategy, deployment plan (i.e. a list of projects, schedule etc.), as required in the NYCSRA.

The requirements process will set the tone for a technical approach or at some point refer to the technical requirements of design and operational capabilities. In this chapter the requirements process are discussed and includes the set of requirements from a user standpoint. The NYCDOT deployment process is covered in Chapters 3, 4, and 5.

2.1.1 Example of Vehicular Traffic Control System (VTCS) Expansion

For example, NYCDOT's may desire to expand "traffic management" under the Vehicular Traffic Control System (VTCS). This is a high-level requirement. Other requirements may include the traffic controllers that must be compliant with the National Transportation for ITS Communications Protocol (NTCIP), in order to interface with a wireless communication medium.

In order to meet these requirements, the implementer (i.e. a consultant hired by NYCDOT to the integrate VTCS system) will begin with the implementation strategy that deploys selected NYCSRA market package(s) and deploys NTCIP protocol in its new ASTC traffic controllers. The implementer will also select a proper wireless networking configuration, testing and evaluation under a Systems Engineering process (SEP). The VTCS system that is integrated in this manner at a project level will ensure that the overall system functions as intended by the user (i.e. NYCDOT). The SEP ensures that user requirements are verified and validated. Thus, requirements and deployment processes are closely coupled.

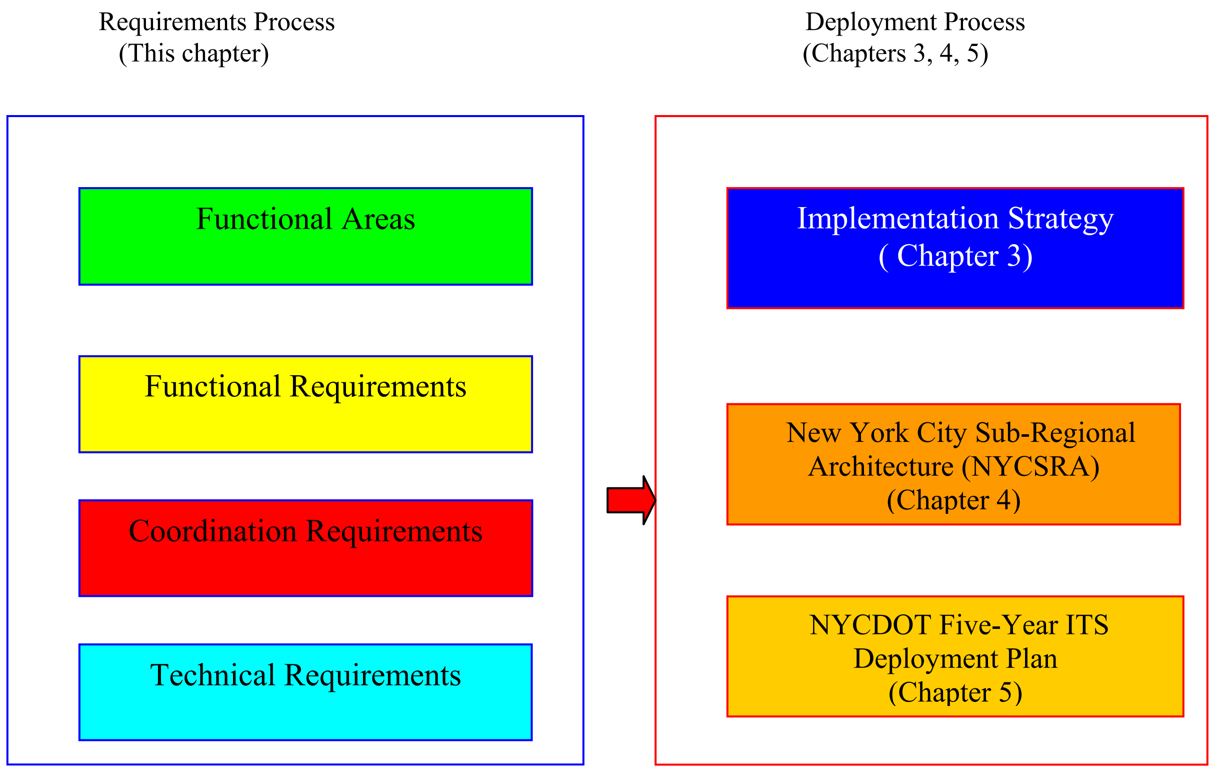

Figure-3 Linkage between the Requirements and Deployment Process

2.2 Functional Areas

NYCDOT has selected key functional areas where operational improvements are sought from ITS investments. In past several decades, the NYCDOT has made significant progress in the expansion of surface traffic control systems, freeway systems, bridges monitoring and traffic management strategies. Despite these impressive independent efforts, NYCDOT has not yet capitalized on the chief opportunity inherent with ITS. That is, *realizing the synergies derived from integrating operations.* One of the axioms of ITS is that whenever an ITS project is deployed for a particular purpose, it invariably generates data, performs functions, or provides infrastructure that can be used for other purposes. The power of ITS lies in linking individual technology components to improve the performance of the entire transportation network in the following 11 areas as identified by the NYCDOT:

1. Traffic Management and Operational Efficiency
2. Freeway Management Systems (FMS) Expansion
3. Congestion management in Central Business Districts (CBDs)
4. Traffic Incident Management (TIM)
5. Emergency Management
6. Travel Management
7. Information for Public
8. Transportation Security and CVO-Truck Tracking
9. Surface Public Transit Coordination
10. Traffic Management Center (TMC)
11. Local and Regional Coordination

NYCDOT has undertaken a significant number of ITS projects that will not only broaden coverage, but will also improve operational capabilities. These projects will require a uniform, consistent, and standardized design and implementation process that will bring all pieces of the puzzle together; merely completing ITS projects will not bring intended results in an integrated system.

Additionally, planning and design phases of ITS deployment must also consider selection of low maintenance technologies and techniques that minimize lane closures and other disruptions. It has been observed by many practicing professionals in the field of ITS that expensive ITS systems that are built on cutting-edge technologies often put burden on operating and maintenance budgets at local agencies, and NYCDOT faces similar situations as well.

This document includes the above functional areas for implementation considerations and introduces a Systems Engineering process to develop functional requirements, implementation and integration needs to deliver operational capabilities. The NYCDOT desires an implementation strategy and guideline that will help develop an integrated system that provides for coordination, communications, and information exchange capabilities among local agencies in order to improve abilities to command and control ITS devices from TMC.

2.3 NYCDOT Functional Requirements

High-level functional requirements stated by users are organized under the following:

- Integration requirements
- Strategic planning requirements
- Local and regional coordination requirements
- Technical requirements
- New York City Police Department (NYPD) traffic management requirements

These high level requirements are based on current needs and may be modified at the project level to reflect specific needs.

2.3.1 Integration Requirements

NYCDOT realizes that while individual ITS projects at each local agency provide benefits for that jurisdiction, greater efficiency and interoperability with local agencies and their ITS systems can only be achieved by well-defined integration of ITS activities at several levels.

With the increasing number of ITS-related systems operated by transportation and transit agencies through out the New York City region, there is a need to develop an integrated, multi-agency transportation system for information sharing among agencies. For example, there is an operational need to coordinate the traffic management functions at centers located at NYSDOT, NYCDOT, NYCT and MTA Bridges & Tunnels. Each native system controls and maintains coordination within its own functional boundaries, but little coordination can be done in real-time unless various centers are communicating to each other in real-time. A communication link and some form of integration of functions to permit the exchange of real-time information and data are required.

This strategic plan recommends that NYCDOT (and other local agencies which incorporate the NYCSRA) implement the following three levels of integration requirements to achieve the above objectives:

- **Institutional level:** Policies, procedures and agreements drawn for common purpose, such co-location of TMC. For example, NYCDOT/NYPD, and NYSDOT are now co-located at the Joint TMC in Long Island City facility and manage and operate (M&O), and coordinate their individual systems and devices and various functions including incident management and emergency management.

- **Systems level:** Interconnectivity with each other's central systems and TMC coordination, communications and information exchange. Center to Center communication capabilities through common protocols and data formats will result in much desired operational coordination. For example, various traffic management systems for freeways and streets are not integrated or interfaced with each other to facilitate cross-systems coordination. The implementation of Sub-Regional ITS Architecture at project levels will eventually rectify these integration difficulties.

- **Devices level:** Sharing of each other's devices in the field and common standards and messages for travelers and motorists, such as displaying common messages during an emergency. For example, Dynamic Message Signs (DMS) sub-systems within an agency (purchased from different vendors) are also in need of integration and also across jurisdictions such as signs operated by Port Authority of NY & NJ and the New York Sate DOT Region-11. If the network is tied together, display of uniform and common messages within the City are possible without human intervention. Fiber optic backbone and wireless communications infrastructure installed and expanded by the NYCDOT will make it possible for tying together these devices and systems.

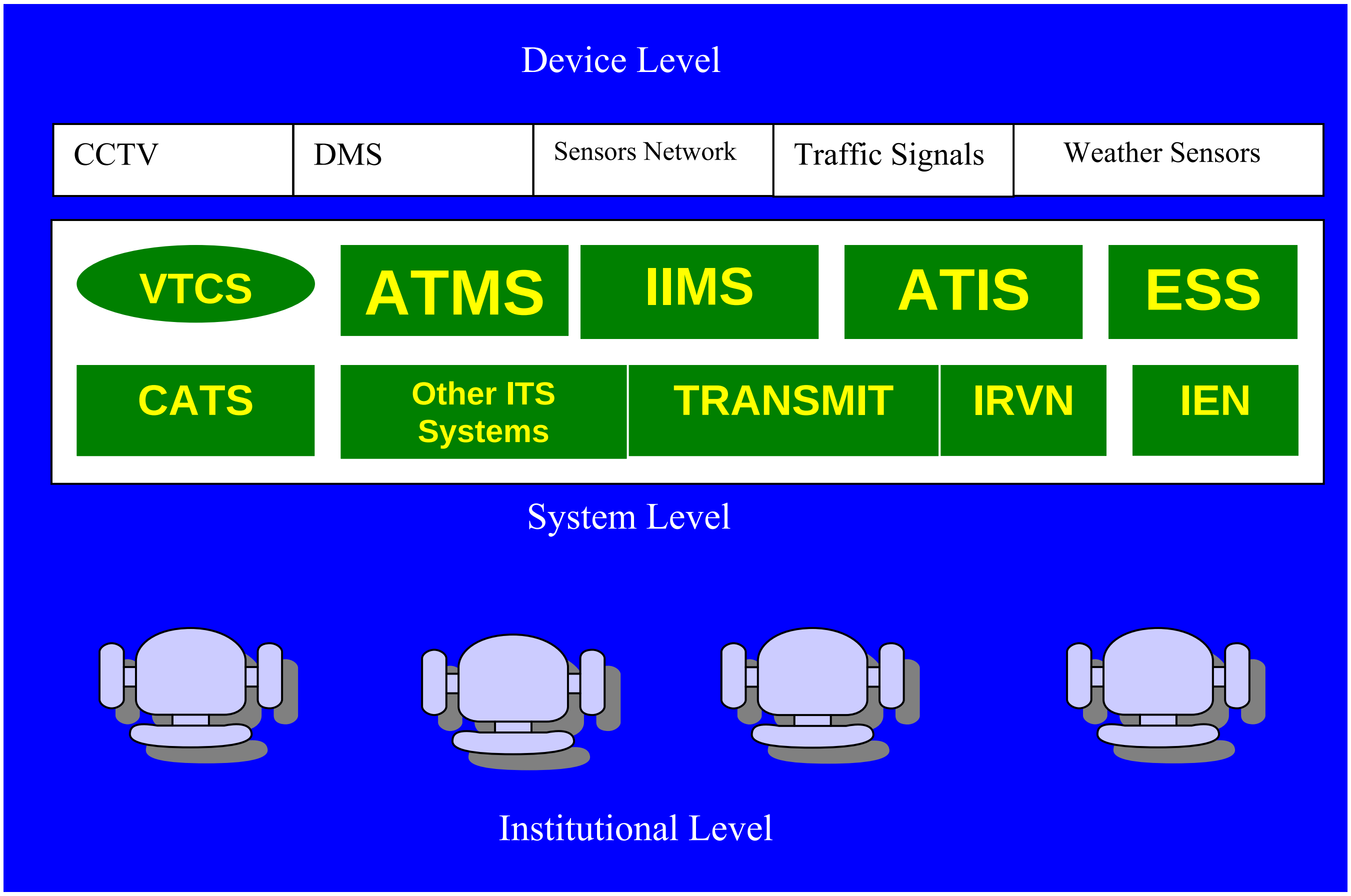

Figure-4 Three Levels of ITS Integration Requirements (Note: not all systems/devices are shown)

NYCDOT/NYPD/NYSDOT are jointly expected to utilize and to have access to the arsenal of ITS systems from all concerned agencies in order to provide support to each other. As shown in Figure-4, operational capabilities at a Joint TMC will be developed through integration at institutional, systems and devices levels. At present, all entities are co-located and operate their own native systems separately and coordinate with each other through manual processes. All centers operate on a 24/7 basis.

Achievement of these objectives will require deployment of the NYCSRA, ITS standards, common protocols and software/hardware interfaces, and common graphic user interfaces.

2.3.2 Strategic Planning Requirements

Strategic planning must consider all pieces of the puzzle and it should address such current needs of NYCDOT such as expansion of freeway management systems (FMS) in all five boroughs, congestion management in Central Business Districts (CBDs), infrastructure for providing current and accurate information to the public and transportation agencies. Presently, New York City is expanding its Vehicular Traffic Control System (VTCS) in Brooklyn and the Bronx by an additional online 2200 intersections online. This expansion requires newer communications technology such as a wireless medium. Such elements must be integrated in existing infrastructure and it must have create capacity to further expand in the future. The mini computers-based central system for VTCS hardware/software platform is also in a need for modernization and it must be included in future considerations. This poses a significant challenge to the NYCDOT.

Preparing for major emergencies in the City is yet another reason why NYCDOT's role in traffic management must be strengthened. ITS plays a significant role and the traffic engineering response was well received by the public and public safety agencies in the City. From a strategic perspective, NYCDOT desires to further improve its communications abilities with agencies in the City and region. There is a strong realization among NYCDOT staff that an integrated approach to ITS projects will result into interconnectivity and capability for system-to-system information exchange among local agencies for common purposes.

The following is the brief summary of the strategic planning and operational requirements discussed by the NYCDOT's traffic engineering, Office of Emergency Response (OER), and NYPD TMC staff.

2.3.2.1 Timely Expansion of ITS Infrastructure and Maintain Focus on ITS Deployment

In the post 9/11 era, there is a realization that NYCDOT should expand ITS infrastructure at a faster rate in order to take advantage of integration and coordination benefits. Newer technologies must be tested and incorporated on an incremental-basis. A method for migrating momentarily to the use of newer technologies that are compatible with current systems needs to be determined. The design phase should include a comparison of available technologies and aim towards the selection of low maintenance options.

- ITS Focus should be placed on the traffic management and congestion. The needs of CBDs needs are to be given priority for real-time response.
- NYC Vehicle Traffic Control System (VTCS) should be modernized and expanded swiftly and efficiently.
- ITS can help relieve congestion on major arterials by using Dynamic Message Signs (DMS) signs on bridges, etc. Messages should be uniform and standardized between agencies in the City.
- The focal point is the Traffic Management Center (TMC). TMC operational capabilities should be strengthened.

2.3.2.2 Consistently Deploy New York City Sub-Regional Architecture

- Provide guidance on how to implement the NYC Sub-regional ITS Architecture – Include as an appendix. It is important because the City must meet the USDOT ITS Rule and Policy in April 2005, in order to continue receiving Federal Funds for ITS projects.
- Show how to (and why to) communicate and coordinate our traffic management functions with each pother.
- Sharing information with common devices – such as the way it is now done with TRANSCOM. (i.e. TRANSCOM already provides access to regional resources and information online through regional workstation and video images from other agency's facilities at the TMC).
- Present the sub-regional architecture in the beginning of the Executive Summary on behalf of executives who can familiarize quickly with the subject matters. Because the architecture provides a top-down approach to ITS, management's buy-in is necessary to deploy ITS.
- There is also a need to briefly cover information on version 5.1 of the National ITS Architecture, and particularly on the Disaster Response and Evacuation User Service.

2.3.2.3 Expand Traffic Management Systems with Adaptive Control Capabilities

- Current VTCS will not work with adaptive traffic signal timing strategies because the field devices are not capable to process intelligence. Current effort to procure and install modern traffic controllers should be expanded in all five boroughs. The NYCDOT is in process of procuring an initial lot of 1000 new controllers that will be implemented in near future in the sub-sub-regional network. These controllers are NTCIP standards-based.
- In an expanded ATMS under TOPIC IV project, NYCDOT intends to utilize 2200 new controllers and this subsystem will be integrated with the rest of the VTCS resulting into 8000 online signals under computer control in the next few years.
- NYCDOT has also determined to re-program or retime signals in parts of the City to adjust to current traffic patterns or movements in order to reflect smooth motion.
- Helping the NYCDOT and NYSDOT in its efforts is the new CIDNY (Coordinated ITS Deployment in New York City) 2005 Program – a Federally Funded project now in its third year. The CIDNY project has created significant ITS awareness and has contributed to technical studies, ITS training courses on standards, incident management, and traffic engineering.
- A NYCDOT traffic signal intersection inventory, as built intersection drawings, and a graphic user interface for management reports is strongly advocated by this plan. Presently on line/off line signals, and the proposed new signals are not listed in a unified manner to assess signal timing strategies.

2.4 Local and Regional Coordination Requirements

The strategies of the NYCTMC and JTMC are heavily used to balance demands with available network capacity on surface streets and highways while another arm of the NYCDOT is heavily involved in restoring capacity by managing and supporting the management of incidents through coordination, cooperation and communications functions. This role is carried out through the Emergency Response Center (ERC) under the Office of Emergency Response (OER):

- **The Role of the ERC** reflects a range of services by providing for coordination, communication (using Blackberries, Nextel, Paging – Communications including radios and walkie-talkies), and support during incident management, emergency management and planned events:
- **Incident Response and Progress Monitoring Requirements**

  a. Emergency responders arrive on-scene to verify (severity, etc.) an incident.
  b. Incident management – roadway monitoring.
  c. Transportation infrastructure damage, repairs and construction activities.
  d. Second level response which focuses on structure, lights, signs, guard rails, roadway, etc that might need attention as a result of the incident.

- **Improve Internal coordination**
  Provide information to executives as needed and to other agencies. NYCDOT is a large agency with services assigned in multi-functions with responsibilities given to units by facilities (i.e. bridges, traffic, highways etc). Coordination among all internal units of NYCDOT, during and after emergencies and repairs is paramount to smooth functioning.
- **Improve External Coordination**
  NYCDOT is multi-modal and multi-agencies are involved in day- to-day operations. Coordination with each other's operation centers such as NYC TMC and NYS JTMC, MTA command center, and Port Authority Bridges and Tunnel facilities is critical to traffic incident management (TIM). Regional traffic management coordination with TRANSCOM and the I-95 Corridor Coalition partners along with the participation in regional ITS activities are important to serve the traveling public and business needs of the City. This strategic plan must give strong consideration to those needs during integration phases of ITS projects.

2.5 Technical Requirements

During the preparation of this strategic plan, NYCDOT staff expressed specific technical requirements. They are listed in this section.

2.5.1 Consider Planning for ITS Elements during Rehabilitation Work

NYCDOT infrastructure management staff should consider ITS needs when planning for rehabilitations projects, such as bridges and highways. ITS benefits during reconstruction work are also significant and must be incorporated.

2.5.2 Institute Uniform Messages on Dynamic Message Signs (DMS)

NYCDOT, NYSDOT, PA, MTA, New Jersey DOT, INFORM, and TRANSCOM have each invested significant funds in creating motorist information systems on highways throughout the region. However, there is very little coordination and uniformity in the various types of messages and policies with respect to roadside DMS's. This lack of uniform message sign standards in the region often confuses the traveling public and the overall effectiveness of information is compromised. It is recommended that NYCDOT take the lead with its regional partners and set an acceptable standard in the City.

2.5.3 Consider System Failures and Disaster Recovery Requirements

The definition of disaster recovery and the related minimum operation requirements should indicate a core functionality of the system. In the case of New York City (where there are about 12,000 traffic signals) recovering the operations of the entire system in the event of an emergency is not feasible. The priority should be given to recovering the operation of critical intersections, bridges and tunnels. System failure issues deal with establishing a disaster recovery center and back up of vital information.

Some of the questions that should be resolved include:

- Does the entire system need to be backed-up?
- Can the entire system fail?
- What is the definition of disaster recovery?
- What are the priorities and the minimum requirements for recovery?
- Has accessibility to communication been addressed during disaster recovery?

2.6 New York City Police Department (NYPD) Traffic Management Requirements

NYPD TMC staff has identified the following requirements:

- **What are the main issues for NYPD?**
  a. Notification for both recurring and non-recurring incidents – in a timely fashion.
  b. The Office of Emergency Response is not always aware of non-emergency work.
  c. The US Army Corps of Engineers provides security for Tunnels and Bridges.
  d. There is a need for a traffic engineering knowledge course for NYPD executive staff.
- **How does ITS help NYPD?**
  e. ITS gets you to the emergency scene. The idea is to Get In / Get Out of the scene
  f. Traffic management helps to coordinate recovery
- **What is the role of NYPD in Traffic Management?**
  g. To disseminate traffic information
  h. Provide traffic control - detect, verify (in real time - clarify), respond, coordinate response and clear
  i. Assess to provide intelligent response
  j. Goal is to reduce and minimize the impact of an incident
  k. Mission Statement to be established later
  l. Responder at the scene has the most information; how to share this with other agencies (i.e. Photos, talking, etc).
- **Integrated Incident Management System IIMS) Role** (patrol cars and support):
  - Helps coordinate with Fire Department and others
  - Currently using older technology plagued with modem issues and still images
  - Need streaming video
  - This technology needs to be in more vehicles and used by other agencies.
  - Although the technology exists, management is not fully embracing (i.e. as FDNY).
  - IIMS (Incident Information Management System) statement due from NYPD
- **NYPD TMC Standard Operating Procedures (SOPs)**
  - Actions/Tasks for Incident Handling.

    - Human mode.
    - Framework.
    - Postings and detours.
    - Filter confidential information from PD.
    - Internal/external sharing.
    - Notifications/Patrol Guide.
    - Implement Evacuation Plan.
- Look at larger requirement and provide assets as necessary.
- Emergency management course.
- Traffic Engineering course for NYPD brass – Executive Development

Chapter 3 Implementation Strategy

3.0 The Need for an Implementation Strategy

"Our mission is to provide for the safe, efficient and environmentally responsible movement of people and goods in the City of New York and to maintain and enhance the transportation infrastructure crucial to the economic vitality and quality of life of our primary customers, City residents."- NYCDOT Mission Statement.

NYCDOT's implementation strategy supports the mission of the agency and has four major components: Application of the NYC Sub-Regional ITS Architecture/ITS Standard; installation of a communication backbone; integration; and ITS training and education. These components are currently in progress at the NYCDOT and will help achieve system capabilities needed for regional and local coordination among agencies, and to manage traffic and travel information at peak operational efficiency.

This implementation strategy is based on a top down approach in order to set ITS priorities and policies from NYCDOT management, and a bottom up approach in order to create communications infrastructure, system functions, and staffing that will support operational needs. This has become possible by demonstrating apparent benefits of ITS and well-coordinated traffic management activities at the NYCTMC as seen during the 9/11 terrorist attacks on the World Trade Center and the blackout of 2003.

3.1 The Elements of Implementation Strategy

The implementation strategy has six elements and each element is briefly discussed below.

1. Application of the NYC Sub-Regional ITS Architecture/ITS Standards
2. Installation of Communications Backbone
3. Integration
4. Emphasis on Interoperability
5. ITS Research, Training, and Education Support by UITSC

6. Systems Engineering Process (SEP)

3.1.1 Application of NYC Sub-Regional ITS Architecture/ITS Standards

NYCDOT has determined that all ITS projects must be based on the requirements of the recently developed *NYC Sub-regional ITS Architecture*, including ITS standards for center to center connectivity and for center to field devices. The Sub-regional ITS Architecture is a *framework* within which an agency can build ITS systems projects for:

- Connectivity (also interoperability)
- Ability to exchange information among all agencies
- Provide effective operational-coordination
- A *technology* neutral manner

With this step, all individual applications will use the same word format, message sets, and protocols and will create interfaces with systems owned and operated by NYCDOT and those systems owned and operated by other local agencies.

For example, the NYCDOT TMC will be able to communicate to the MTA-Bridges and Tunnels TMC on Randalls Island, and at Jamaica Station as soon as a missing fiber optic link is installed and appropriate market packages from the Sub-regional ITS Architecture are procured and implemented. Implementation refers to the software that will create the interfaces and communication relative to the information flows indicated in the customized market package diagrams in order to provide the transportation services identified by the NYCSRA. This will provide real-time information exchange and coordination of traffic management between two agencies who are actively involved in managing congestion.

A detailed discussion on the NYCSRA is provided in Chapter 4. The chapter contains specific coverage for NYCDOT ITS deployment needs. Additional information on the NYCSRA is also presented in Appendix-A.

3.1.2 Installation of a Communication Backbone

Communication links are critical components in any ITS project. NYCDOT has instituted a series of projects that deploy fiber optic cable which will provide data speed and bandwidth capacity for the transfer of information. For NYCDOT, these links apply as follows:

- Fiber optic or wireless access points for Center to field devices.
- Communication links from a Center (TMC) to another Center using a wireless network or direct connection using fiber optic.
- CDMA service (latest available in New York City) from service providers to interface all CCTV, sensors, and data from individual locations to a TMC.
- A Wireless network for traffic signals is now being investigated for possible future application with a dedicated city owned frequency band.

3.1.3 Integration

"ITS deployment has been concentrated in large urban metropolitan areas but has not occurred in an integrated manner" - U.S General Accounting Office.

The above quote is taken from the 1999 ITS Strategic Plan and is still true today. There is a strong case for the integration of ITS projects in New York City. Integration needs to occur both within and between NYCDOT, and other local, regional transportation and public safety agencies.

In recent years, transportation agencies in the City have expanded their ITS operations and have gained valuable experience in system development efforts. However, their systems are still operating under a stand-alone mode or with operator-intervention. System to system connectivity within and among agencies is a reality of present day ITS in New York City.

For example, many agencies still have multiple message signs systems, and they don't "talk to each other". Several freeway management systems in NYC also operate on a stand-alone basis and cannot exchange information with one another because they are simply not integrated.

System operators have to ‘jump from one system to other” to derive information. Also, systems from different agencies cannot exchange information in real-time because they are not fitted with common protocols and standards-based interfaces. Such technical difficulties, organizational constraints, and lack of tools and strategies hamper efforts to implement corridor management (i.e. New York City’s five borough environment, numerous bridges and tunnels located in closed areas, and congestion bottleneck scenarios are most suitable for corridor management).

To eliminate such difficulties in the information exchange among various ITS systems, and to realize peak efficiency and full benefits from ITS investments, the following components must be integrated:

- Communications
- Operations
- Common protocols
- Information exchange with common data formats and data storage capability.
- Transportation and Homeland security needs

ITS has lead the initiative in New York City by utilizing existing and emerging technologies to improve the safety and operational efficiency of the transportation network. ITS concepts have taken hold in the New York City region and have now reached a significant level of deployment level where ITS functions are expanded (i.e. CCTV, Sensors, Weather stations, Wireless, Fiber Optic etc.), and extended to cover all parts of the City. While the technical and geographical expansion is taking place, there is a greater realization that ITS systems, projects and coordination process must be integrated for better results, we must persist and work with other local agencies for similar objectives. This is necessary because other local agencies in the City are also engaged in implementing ITS components with similar functions and services.

3.1.4 An Emphasis on Interoperability

There is great expectation that ITS investments in the City will result into an interoperability (i.e. an ability to communicate with each other, exchange information and facilitate coordination needs). The impact of the NYCSRA on interoperability is expected to be significant. It is anticipated that local agencies will begin to deploy market packages suitable for each other's needs, and eventually result in an acceptable level of interoperability.

Interoperability will be possible if common ITS standards—data elements, messages, and protocols— are deployed within a native system and/or other systems of the local agencies. For example, TRANSCOM's System for Managing Incidents and Traffic (TRANSMIT) and Interagency Remote Video Network (IRVN) are providing interoperability to agencies in three states. Both projects are well integrated for common benefits. Both were developed under the concept of designing it just once in order to efficiently use it among all, in addition to a single source of maintenance. While these examples are of regional nature, NYCDOT should consider applying integration techniques across all projects for interoperability and economies of scale.

3.1.5 Research, ITS Training, and Education Support by UITSC

ITS applications are based on computer, telecommunications and information technologies and require specific Knowledge, Skills and Abilities (KSAs) on behalf of system engineers, transportation engineers, policy makers, planners, and system operators at TMC's. Field technicians, operation, and maintenance personnel also need specialized training. As ITS systems are expanded and more elements are added, there is a growing need for training and education program that will provide continuous training to maintain peek performance at all levels of system design and operation.

Modern ITS devices such as advanced traffic controllers, dynamic message signs, and central systems require system testing, procedures and coordination techniques for team members. As a result, NYCDOT and NYSDOT with support from FHWA have jointly established a specific project called – Coordinated ITS Deployment in New York City (CIDNY) with the Urban ITS Center (UITSC) at Polytechnic University (Brooklyn). The UITSC has developed a series of specific training courses for NYCDOT/NYSDOT and other transportation and public safety organizations, in support of ITS deployment in the City. For example, a specialized training course on *National Transportation Communication for ITS Protocol (NTCIP)* was conducted at UITSC to support ITS projects. Recently, a special course on ITS Deployment in New York City was developed and provided to a number of interested candidates.

The UITSC undertakes feasibility and evaluation studies, and conducts research and test-bed for emerging technologies, and simulations to assess effectiveness in local environment prior to implantation. For example, UITSC conducted origin-destination studies for EZ-Pass tags on East River Bridges, in addition to conducting a controlled simulation process for the feasibility of adaptive traffic signal strategies in the five boroughs. The aim is to support NYCDOT and NYSDOT on the evaluation of various programs and technologies. A detailed discussion on research and training projects is covered under a separate chapter.

3.2 Systems Engineering Process (SEP)

The NYCDOT implementation strategy includes the Systems engineering Process (SEP) as required guidance to implementers for project development. The main objective is to achieve a uniform design and systems implementation among all components of ITS deployment.

Systems engineering is a discipline that has been used for over 50 years and has its roots in the building of large, complex systems for the Department of Defense. Systems engineering is an approach to building systems that enhance the quality of the end result. The expectation is that its application to transportation systems projects will make projects more effective in developing and implementing the systems they are intended to be built.

In this section, a widely utilized Systems Engineering Process (SEP) is discussed.

3.2.1 Introduction

A SEP is a structured way of thinking that:

- Allows us to build systems based on our needs with reliability and stability.

- Traces decisions and corrects them in time to avoid costly modifications later
- Improves chances of system development on time and within budget.

Typically, an SEP structure is applied in a series of logical steps to NYCDOT projects in order to meet the above objectives. These steps, if applied to all NYCDOT projects, will result in an overall system that functions in harmony and in an integrated manner. Currently, this structure is not used by local agencies. Typically, the following steps will be needed:

- Before the project begins, the NYCDOT system manager initiate a review of the NYCSRA and extract information relevant to NYCDOT, and relates that information to the project needs expressed by NYCDOT. To an extent, this document has provided that link (see Figure-1).
- In the next step, the system manager will develop a concept of operations (i.e. con-ops); it will generate a set of functional requirements based on the needs of the project. This step will take place at the initial stages of project development.
- The middle step will allow the development of project specifications, design, and implementation requirements. A contractor will then build the system or supply it as necessary.
- Finally, the system manager will typically conduct testing and acceptance procedures to complete verification and validation process that ensure desired functionality (i.e. This is known as 'traceability' in the industry standard "Vee" diagram which ensures compliance with testable system requirement stated in the specifications). A detailed discussion on SEP and the "Vee" model is provided in the next sections.

3.2.2 Elements of the Systems Engineering Process (SEP)

The systems engineering process (SEP) allows for building stable and reliable systems by using an incremental and traceable approach. The incremental stages of the systems engineering process model consists of the sub-regional architecture, concept of operations, functional requirements, detailed design, implementation, integration testing and verification, system verification, operations maintenance and validation and consistency. Testing plans and verification, and validation need to be carried out as a part of each of these steps. A brief discussion on each component is provided below and is shown in Figure-5:

- The Concept of Operations (ConOps) defines the physical environment in which a given system will operate as well as the relationships between that system and the responsibilities of the agency that is deploying it. ConOps is developed by the stakeholders as a result of an exchange of information to determine common goals and to devise a strategic plans based on the sub-regional architecture and standard operating procedures (SOPs).
- Functional requirements outline the specifications and esign of the system.
- Testing needs to be done at several stages: unit test, integration test, system test. Unit testing involves checking for standards conformity as well as component testing. Integration testing is confirming the functionality of the subsystems. Finally, system testing is the end-to-end inspection of the completed system, and its evaluation against the specifications and standards.
- Testing can be carried out by the first, second or third parties, depending on available resources. NYCDOT will face these issues during the integration process.

The main points of the systems engineering process (SEP) expressed by NYCDOT included the following:

- Documentation is an important aspect of the systems engineering process for traceability purposes.
- Maintenance and operation need to be taken into consideration when drawing up the design of a system.
- Translating concept of operations into functional requirements is one of the biggest challenges in the SEP.
- There is a validation stage between the steps in the systems engineering process. Testing has to be performed at every stage. Late testing will result in ineffective implementation and the corrections of errors are more costly when detected in later stages.
- It is a good approach for the first party (NYCDOT) to establish the testing procedures and to perform the testing on the assumption that there are qualified personnel and funds

available. This task, if done by others, will require additional consideration in contract responsibility.

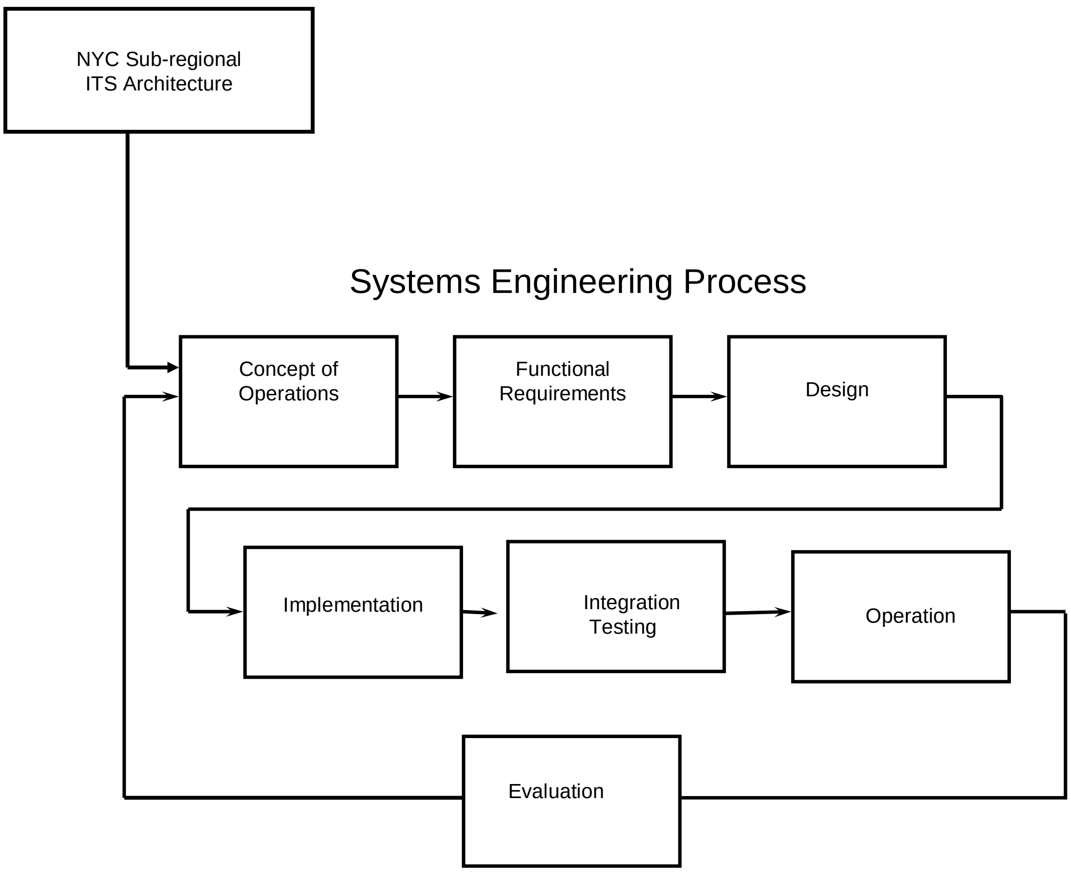

Figure- 5 Systems Engineering Process (SEP) for ITS Deployment

3.2.3 Systems Engineering Activities Supported by the Vee Model

Vee model shown in Figure-6 adds levels of decomposition on the left side from system level to lowest component detail. It adds levels of integration on the right side for subsystem buildup, testing, verification and validation.

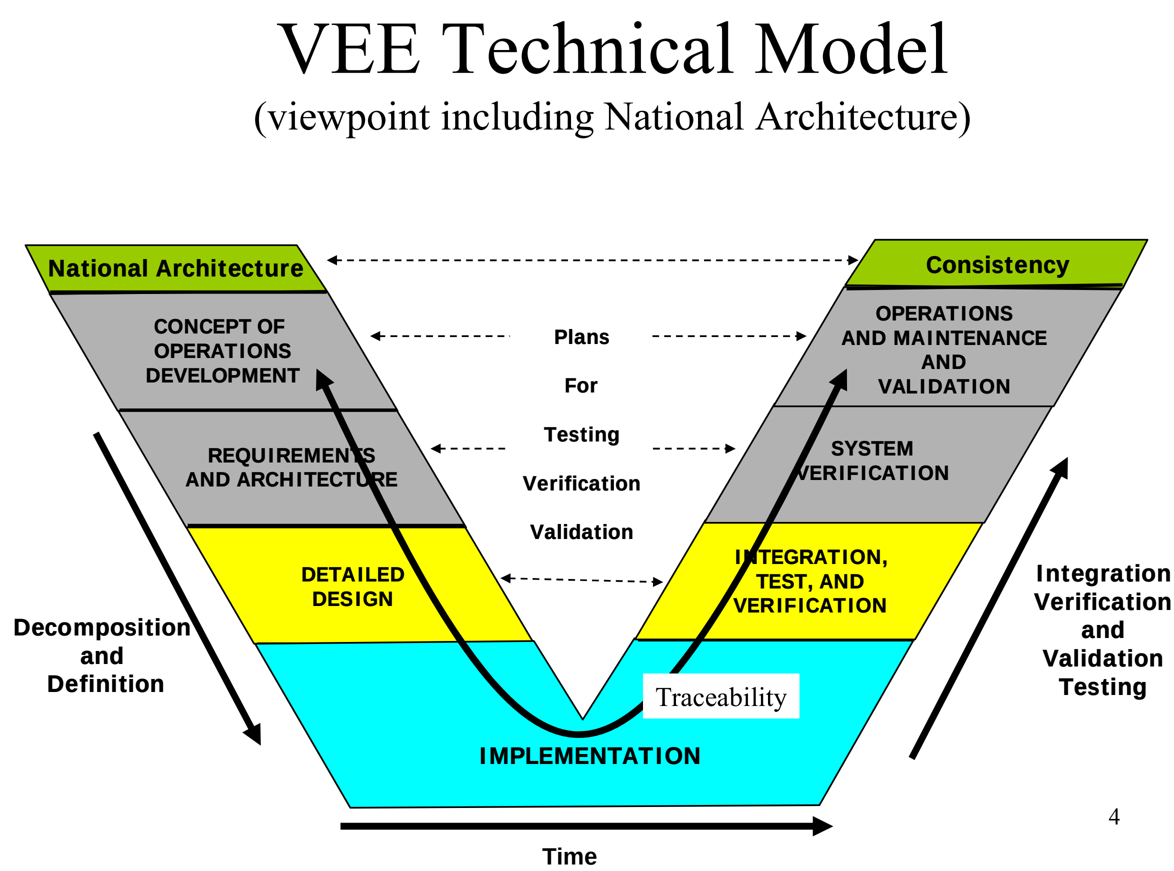

Figure-6 Vee Model

For an effective integration process at the project level and within various subsystems, NYCDOT must consider utilizing the process and directing their system implementers to utilize the SEP in their project-level design activities (Ref. 4, 5).

3.2.4 Systems Engineering Impacts on System Implementation (Ref.5)

Systems engineering is a process. It is not just a set of tools. As such, systems engineering activities occur throughout the system development life cycle. A common set of stages in a system development life cycle and the systems engineering technical activities that accompany them include the following (Ref.5):

- **Conception**. The stage in which the need for a system (or major system enhancement) is first identified. The principal systems engineering activities in this stage revolve around feasibility assessment. Is the system feasible? Can a feasible system be built in a reasonable time and at a reasonable cost? How much time is required to build this system? How much should it cost? These are the types of questions that a systems engineer focuses on during this stage.

- **Requirements Analysis**. During the requirements analysis stage, the systems engineer focuses on ensuring that the requirements defined for the system clearly state what needs to be done rather than how it should be done. The systems engineer also works at ensuring that the requirements defined are clear, complete, and correct. The systems engineer schedules reviews with the stakeholders in the system to ensure that all parties involved in building the system have the same understanding of the meaning of each requirement. Stakeholders include the contractor selected to build the system.

- **Design**. During this stage, the systems engineer helps flesh out the details of the system, helping make decisions about the best way to satisfy the system's requirements. In order to help overcome technical uncertainty, the systems engineer may conduct trade-off studies, use modeling and simulation to analyze potential system performance, build prototypes to assess the technical feasibility of a proposed solution, or perform in-depth analyses of different technologies to assess their applicability to the system under development. The systems engineer also conducts design reviews with project stakeholders to ensure that the design approach selected is consistent with their needs and expectations.

- **Implementation**. Systems engineering activities during this stage (sometimes called ***Development***) focus on ensuring that what gets built matches the agreed-upon design. One specific subset of systems engineering activities during this stage is software engineering, designed to ensure the quality of the software in the system. These activities include walk-throughs of developed programs (where programmers review the work of another programmer, to determine whether any errors exist). In addition, software engineers define standards for code development and ensure that these standards are followed. The systems engineering activities aren't solely directed at software. It is also important to ensure that hardware developed (or modified) during this stage also matches the agreed-upon design. Hardware inspections are one technique for quality control during this stage.

- **Testing**. Systems engineers create complete and comprehensive test sets that effectively exercise the system and its components. They also analyze test results and assess the degree to which the system satisfies its requirements.

  Testing is important to software development because it uncovers errors in the logic of the programs. Although it is unlikely that all execution paths through a program can be covered, systems engineers focus on identifying test coverage to ensure that mission-critical functions are thoroughly tested.

Hardware components need to be exercised as part of the testing process to ensure that they perform as expected, and as the system requires. One should recognize that hardware testing needs to take place under realistic conditions of use, not simply a "laboratory" environment. Some hardware components, e.g., global positioning system receivers may work quite well under controlled climatic conditions, yet fail when exposed to realistic weather conditions, such as below-freezing temperatures.

- **System Acceptance**. Some of the key systems engineering activities during this stage look at the training of system users (includes NYCDOT VTCS and TMC operators) and the approach for fielding the system. New systems, or enhanced versions of existing systems, need to be fielded in a manner that does not disrupt normal business operations. Systems engineers plan these "rollout" activities to affect a smooth transition to the new system. This stage also involves the final testing of the system by its users to ensure that it meets their requirements.

- **Operation and Maintenance**. After the system is fielded, systems engineers focus on ensuring the system continues to meet its performance goals. Should problems arise, one will diagnose the causes, and determine how to solve the problem with minimal delay. In addition to fixing problems that occur, systems engineers also assess potential enhancements and upgrades to system capabilities. This is particularly critical, considering the normal incremental, evolutionary approach to fielding modern transportation systems.

  For example, in the current NYCDOT VTCS expansion project, over 1000 new ASTC traffic controllers are being tested and installed in the field using NTCIP protocols. Significant feedback from operation and maintenance will be incorporated in other projects as deployment activities expand.

Chapter 4 New York City Sub-Regional ITS Architecture (NYCSRA)

4.0 Introduction

The National ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems (ITS) and defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS.
- The physical entities or subsystems where these functions reside (e.g., the roadside or the vehicle).
- The information flows and data flows that connect these functions and physical subsystems together into an integrated system.

4.1 User Services

The National ITS architecture process begins with the cluster of user services as defined under 'bundles'. The New York City Sub-Regional ITS Architecture (NYCSRA) is based on the National ITS Architecture and blends with the local transportation environment in New York City.

National ITS Architecture Defined ITS User Services

User services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. User services, including the corresponding user service requirements, form the basis for the National ITS Architecture development effort. The initial user services were jointly defined by USDOT and ITS America with significant stakeholder input and documented in the National Program Plan. The concept of user services allows system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs. New or updated user services have been and will continue to be satisfied by the National ITS Architecture over time.

To this date, there are 33 user services globally identified and defined in seven bundles by the Architecture effort as follows:

Travel and Traffic Management
1. Pre-trip Travel Information
2. En-route Driver Information
3. Route Guidance
4. Ride Matching And Reservation
5. Traveler Services Information
6. Traffic Control
7. Incident Management
8. Travel Demand Management
9. Emissions Testing And Mitigation
10. Highway Rail Intersection

Public Transportation Management
11. Public Transportation Management
12. En-route Transit Information
13. Personalized Public Transit
14. Public Travel Security

Electronic Payment
15. Electronic Payment Services

Commercial Vehicle Operations
16. Commercial Vehicle Electronic Clearance
17. Automated Roadside Safety Inspection
18. On-board Safety And Security Monitoring
19. Commercial Vehicle Administrative Processes
20. Hazardous Material Security And Incident Response

Emergency Management
21. Emergency Notification And Personal Security
22. Emergency Vehicle Management
23. Disaster Response And Evacuation

Advanced Vehicle Safety Systems
24. Longitudinal Collision Avoidance
25. Lateral Collision Avoidance
26. Intersection Collision Avoidance
27. Intersection Collision Avoidance
28. Vision Enhancement For Crash Avoidance
29. Safety Readiness
30. Pre-crash Restraint Deployment
31. Automated Vehicle Operation

Information Management
32. Archived Data Function

Maintenance and Construction Management
33. Maintenance and Construction Operations.

Source: http://itsarch.iteris.com/itsarch/html/user/userserv.htm USDOT Project Team

4.2 Consideration for NYC Sub-Regional ITS Architecture (NYCSRA)

There are three key reasons why NYCDOT must consider the deployment of NYCSRA:

- To continue qualifying for federal funding for ITS projects, NYCDOT must begin to implement NYCSRA at project levels in 2005, under FHWA Rule 940 (see Appendix-E).
- Interconnectivity among agencies and systems is a priority for effective traffic management in the City.
- NYCDOT is hiring engineering consultants to design and implement ITS projects. There is a need for guidelines and uniform procedures for these experts to follow to implement market Packages developed by NYCSRA and internal DOT ITS focus.

For example, it is likely that an engineering service consultant to be on board in 2005 and will be charged to ensure the implementation of the ATMS08 market package from the NYCSRA. A detailed discussion below will provide further clarification on the role of NYCSRA (below). If this is done, the project will be under federal compliance, and will provide NYCDOT much desired interconnectivity between one or more TMC's.

4.3 Market Packages Functional Areas

The NYCSRA ITS Functional areas are identified by the local users and based on their needs developed a series of market packages for each functional area and agency. This effort was placed on a fast track development process primarily to produce the local architecture in a timely fashion (2005) to comply with USDOT ITS Rule and Policy, which requires use of a regional architecture in order to continue receiving federal funding for ITS projects.

For detailed information on the NYCSRA, please refer to Appendix-A and Appendix-E for information on USDOT ITS Rule and Policy.

Adopting functional area terminologies from the National ITS Architecture, the NYCSRA (Ref.1) has defined customized market package diagrams for New York City, and is organized by transportation functional area as follows:

- **Archived Data Management Systems (AD)** - These are systems used to collect transportation data for use in non-operational purposes (e.g. planning and research).
- **Advanced Public Transportation Systems (APTS)** - These are systems used to more efficiently manage fleets of transit vehicles or transit rail. This functional area also includes systems to provide transit traveler information both pre-trip and during the trip.
- **Advanced Traveler Information Systems (ATIS)** - These are systems used to provide static and real time transportation information to travelers.
- **Advanced Traffic Management Systems (ATMS)** - These are traffic signal control systems that react to changing traffic conditions, and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions. This functional area also includes systems used to monitor freeway (or tollway) traffic flow and roadway conditions, incident management and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. These systems may also provide information to motorists on the roadway.
- **Commercial Vehicle Operations (CVO)** - These are systems used to more efficiently manage commercial fleets, monitor freight movements, hazardous materials movement, safety inspections, and electronic clearance (both domestic and international).
- **Emergency Management (EM)** - These are systems that provide emergency call taking, public safety dispatch, and support emergency operations center operations.
- **Maintenance and Construction (MC)** - These are systems used to manage the maintenance of roadways and equipment in the region, including winter snow and ice clearance, and construction operations.

4.4 Market Packages for NYCDOT

Market packages define potential ITS deployments in both narrative and diagrammatic form. Market package diagrams show which ITS systems are required to work together (across different operators, whether public or private) to deliver a given transportation service. Market packages are designed to address specific transportation problems (for example, there is a market package for incident management) and needs and relate back to the ITS services and their more detailed requirements.

Market packages collect together two or more system elements (from the same or multiple stakeholders) that must work together to deliver a given transportation service and the architecture flows that connect them and other important external systems on the boundary of ITS. In other words, they identify the ITS system elements required to implement a particular transportation service.

The development of the NYCSRA to this point has focused on creating and documenting a vision of what ITS services are desired for the New York City region for the next twenty years. This vision has focused around the Regional Transportation Plan (RTP) and the Transportation Improvement Plan (TIP); by determining what the regional transportation goals are, what transportation services are needed in the region to attain those goals, and what interfaces and information flows are needed between stakeholders to support those transportation services.

The above text is taken from the *New York City Sub-Regional ITS Architecture Implementation Strategy (*Appendix-B).

4.5 Example of Incident Management Market Packages (ATMS08)

The main product of the NYCSRA is a set of Market Packages for the NYCDOT and other agencies. These packages serve a defined need or a function. and are assigned a specific identification number based on Version 4.0. The following functional areas examples of market packages will illustrate the concept and data flow between entities.

Example of NYCDOT Market Package

ATMS03 - Surface Street Control

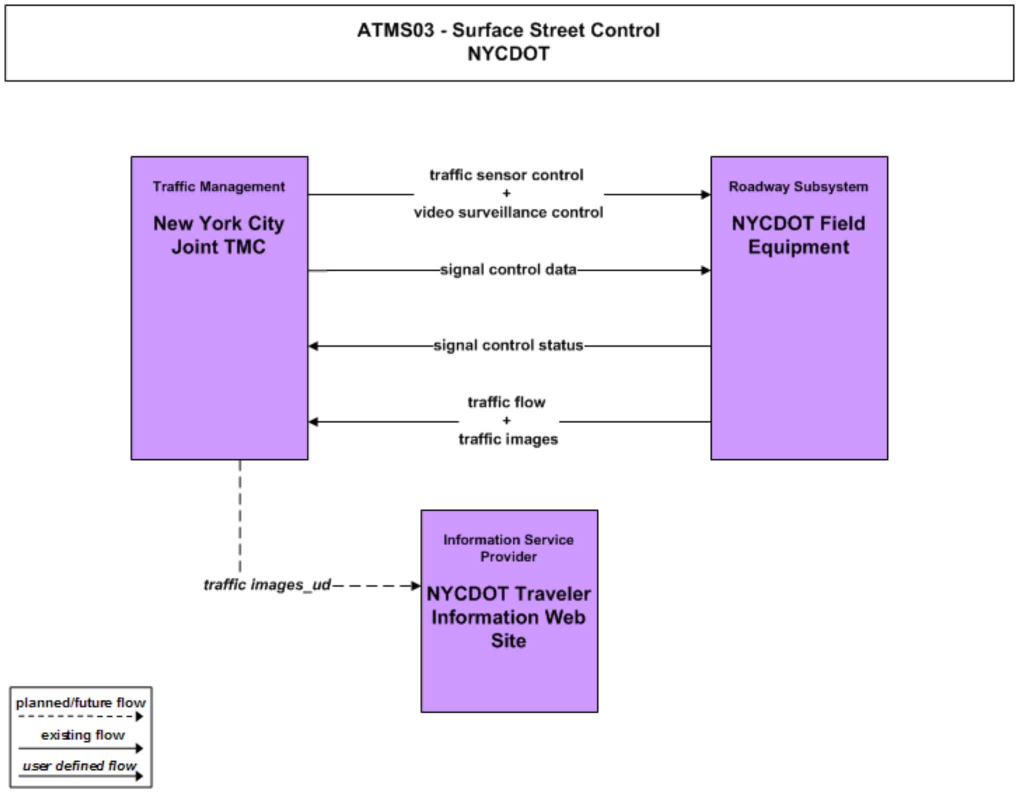

Figure-7 Surface Street Control Market Package for NYCDOT

As shown in Figure-7, this market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. A range of traffic signal control systems are represented by this market package ranging from static pre-timed control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. Additionally, general advisory and traffic control information can be provided to the driver while en route. This market package is generally an intra-jurisdictional package that does not rely on real-time communications between separate control systems to achieve area-wide traffic signal coordination. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would be represented by this package. This market package is consistent with typical urban traffic signal control systems.

Example of NYCDOT Market Package

ATMS06 - Traffic Information Dissemination

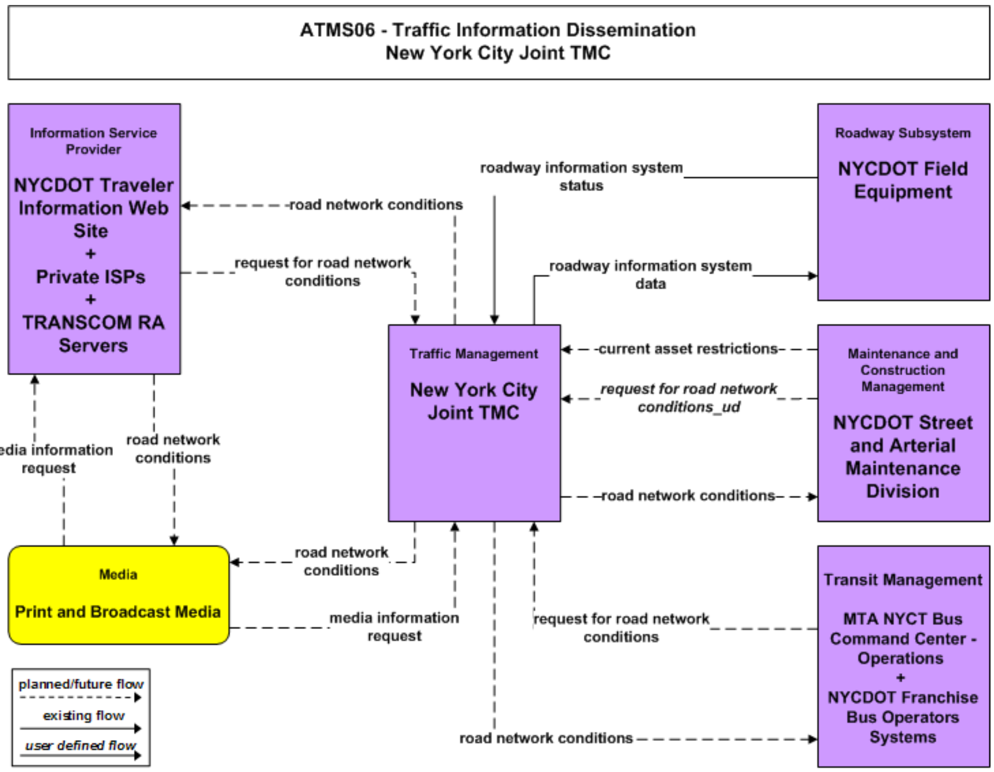

Figure-8 Traffic Information Dissemination Market Package for NYCDOT

As shown in Figure-8, this market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and

Construction Management subsystem allows real time information on road/bridge closures due to maintenance and construction activities to be disseminated.

Example of NYCDOT Market Package

ATMS08 - Incident Management System

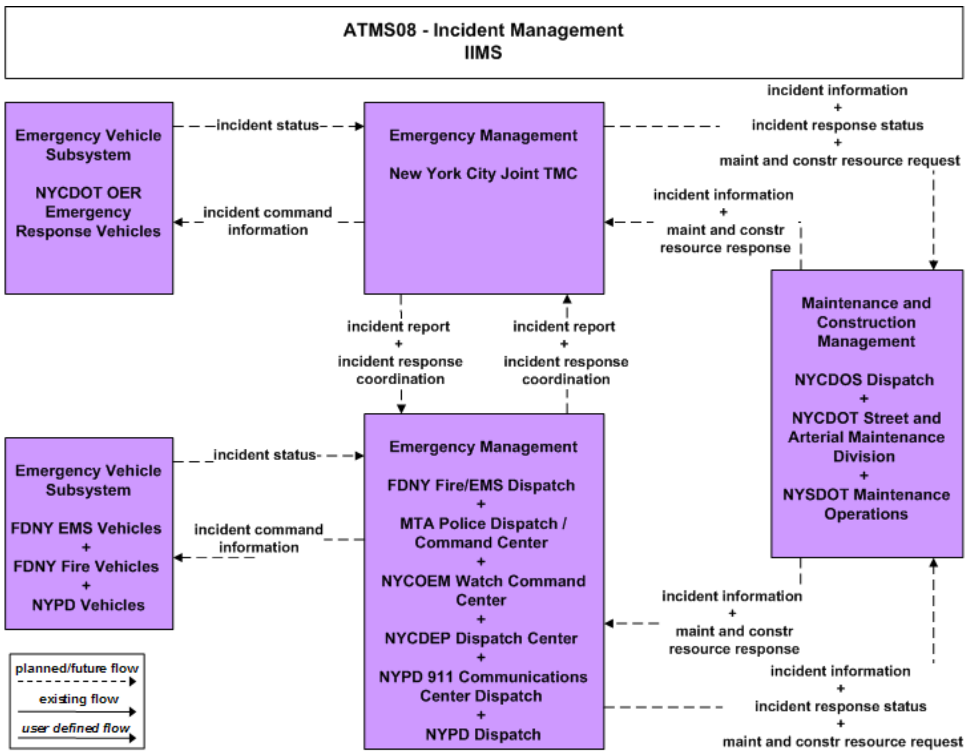

Figure-9 Incident Management Market Package for NYCDOT

As shown in Figure-9, this market package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The market package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as weather service entities and event promoters. Information from these diverse sources are collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems.

Chapter 5 The NYCDOT Five-Year ITS Deployment Plan

5.0 Background and Purpose of ITS Deployment

"Because New York City can no longer easily expand the capacity of our transportation system, ITS has become a key solution to the City's critical problems of congestion, security, safety, air pollution, and quality of life. We at NYCDOT believe that the City's complex, multi-modal transportation system has become more efficient with better management through ITS." (Ref.11)

Traffic management has been a key part of City's public service and transportation infrastructure. Since the late 1960's, deployment of ITS has gained momentum and generated significant benefits to the City's economy and social life. ITS technologies in various forms have enabled the City to manage daily incidents and large-scale emergencies and events. For example, during and after the 9/11/01 disaster caused by the terrorists' attacks on the World Trade Center required unparallel support from City's traffic management resources included ITS infrastructure. The successful support provided by the NYCDOT TMC during and after 9/11/01 focused on emergency management with the help of ITS elements and the central integrated Vehicular Traffic Control System (VTCS). NYCDOT desires to improve its ability to communicate, coordinate, and exchange information with other local organizations in order to improve operational efficiency. As a result, NYCDOT has set key objectives for ITS deployments as follows:

1. Expansion of ITS Sub-systems, both functional and geographical
2. Interconnectivity with other partners and systems
3. Integration of all NYCDOT ITS components
4. High speed communication Network with fiber Optic/wireless mediums
5. Improvement in operational efficiency

Additionally, NYCDOT intends to implement the New York City Sub-Regional Architecture (NYCSRA) at project levels and intends to procure and integrate standards-based ITS devices.

5.1 Relationship between Functional Categories and Requirements

The deployment program within NYCDOT occurs in several functional categories. NYCDOT has also identified key requirements. Table-3 shows the loosely-defined relationship between ITS functional categories and supporting requirements. For example, TOPICS-IV expansion project (Row # 3 in Table-3) applies wireless communications that will be integrated with the VTCS. It will improve operations by providing on-line capabilities to signal timing.

Table-3 Relationship between ITS Functional Categories and NYCDOT ITS Requirements

#	Functional Category	Expansion	Communication	Integration	Interconnectivity	Efficiency
1	Systems engineering Support Services (Engineering design, plans, specifications, inspection, and integration.	√	√	√	√	
2	ITS Systems Center to Center Interconnectivity (Multi-agency ITMS)		√	√	√	
3	TOPICS-IV Traffic Signals Computerization (Communications and field installation in BK/BX).	√		√		√
4	Procurement of Actuated Signals Traffic Controllers (ASTC) and Battery Backup Systems for Signals.	√				√
5	Advanced Traffic Management System (ATMS) for Arterials.	√		√		√
6	Freeway Management Systems (FMS) Expansion (CMAQ Projects)	√				√
7	ITS Elements for NYC Bridges.	√	√			√
8	Fiber Optic and Wireless Communication Systems		√			
9	Advanced Traveler Information Systems					√
10	Web-based Travel Information					√
11	Commercial Vehicle-Truck Tracking System					√
12	NYCDOT Traffic Management Center		√	√	√	√
13	ITS Research, and Training & Education Support (by UITSC)					√

Note: Integration process ties communications, operations, common protocols, information exchange together.

5.2 The NYCDOT Five Year ITS Deployment Plan

Table-4 outlines NYCDOT's ambitious ITS deployment plan under key categories.

Table-4 The NYCDOT Five Year ITS Deployment Plan (2005-2009)

#	Title	Year	Est. Cost	Status
	Systems Engineering Support Services			
1	Engineering Design & Inspection for an ITS Related and Planning , Contract-A Project 1 a, TOPICS-IV	2005	$5.0 m	In progress
2	Engineering Design & Inspection for an ITS Related and Planning , Contract-B	2005	5.0	In progress
3	Systems engineering Agreement # 11 for TOPICS-IV.	2005	-	Ongoing
	ITS Systems Center to Center Integration			
4	New York City Multi-agency Integrated Transportation Management System (ITMS) c. Design phase-Functional Requirements d. Hardware/Software Integration, TMC to TMC Interconnectivity, Equipment MTA Jamaica Station and Randall Island TMCs	2005	0.9 1.8	Planning/Design
	TOPICS-IV Traffic Signals Computerization, Brooklyn/Bronx			
5	Communications-Wireless Network	2005-2006	8.0	Planning/RFP
6	Field Construction (Furnish & Install)	2006	8.0	Planning
	Procurement of Actuated Signals Traffic Controllers (ASTC)			
7	Actuated Signals Traffic Controllers (ASTC) Procurement Phase-1 1000 units	2002-2005	5.5	In progress
8	ASTC Procurement Phase-2, 5000 units 2200 for TOPICS-IV Brooklyn/Bronx 2800 for Non-VTCS applications	2005-2008	30.0	Planning
9	Battery Back-Up System for 1000 signals	2005	2.0	In progress
10	Adaptive Traffic Control System (S.I. College)	2006	-	Conceptual
	Advanced Traffic Management Systems Expansion			
11	Local Streets Network and Incident Management System (Install fiber Cable Williamsburg Bridge to Battery park)	2006?	4.0	Planning
12	FDR Drive ITS Elements (CCTV, DMS, Detection). To Harlem river drive.	2005-06	4.0	Planning
13	Fiber Network for Brooklyn, Bronx and Queens	2006-09	4.6	Planning
14	Lower Manhattan ITS	2005	-	Planning
15	Williamsburg Bridge ITS Elements	2004	-	Completed
16	Queens Borough Bridge ITS Elements	2004	-	Completed
17	Manhattan Bridge ITS Elements	2004	-	Completed
18	Third Avenue Bridge ITS Elements	2006	-	Planning

Table-4 The NYCDOT Five Year ITS Deployment Plan (2005-2009) (Continued)

#	Title	Year	Est. Cost	Status
Advanced Traffic Management Systems for New York City Expressways CMAQ (Congestion Management and Air Quality) Funded				
19	Implementation of ITS System Along New England Thruway (I-95) (Pelham Parkway-City line- BRONX)	2007	$2.45 m	Programmed
20	Jackie Robinson Parkway (GCP- Jamaica Ave., six miles)-Queens	2006	2.20	Programmed
21	Cross Island Parkway (Whitestone Parkway to Southern State Parkway)-Queens	2007	1.35	Programmed
22	Henry Hudson Parkway (GWB-City line)	2007	3.20	Programmed
23	Belt Way , Brooklyn-Queens (65 street to Southern State Parkway)	2006 2007 2008 2009	2.00 1.50 1.50 3.10	Programmed
24	Korean War Memorial Veteran Parkway, Staten Island (Richmond Ave. to Outer Bridge Crossing)	2008	2.50	Programmed
Advanced Public Transportation System (APTS)				
25	Traffic Signal Priority Control for Transit Vehicles-Staten Island (10 intersections on Victory blvd.)	2005	0.70	In Progress
Advanced Traveler Information System (ATIS)				
26	Advanced Traveler Information System –for 15 miles Citywide installation, 50 CCTV, 630 RTMS detectors for travel time display	2006?	4.00	Planning
Web-based Traveler Information ATIS				
27	Vehicle-flow rates, Maps, Sensor Network for Travel time estimation	2006	-	Conceptual
Video Based-Radiation Detection System for Evacuation				
28	Commercial-Truck Detection System for Radio Activity	2006	-	Conceptual

Chapter 6 Role of the Traffic Management Center (TMC)

6.0 Background

According to the Institute of Transportation Engineers (ITE), a Transportation Management Center (TMC) is defined as a central facility that controls, monitors, and manages the local streets, highways, transit and bridges/tunnels control systems within its control area.

In recent years, TMC's have become a focal point of transportation management strategies. In New York City, ITS has made a transition from a conceptual stage to a full-scale deployment phase where large investments are made to create technical and operational capabilities at the TMC. The NYCTMC has evolved over the past decades and has become a significant part of the City's traffic management function and support for emergency management. In recent years, it has become an integral part of intelligent transportation systems (ITS). The NYCDOTTMC deploys modern technology and complex software applications developed over several years on a 24/7 basis. The TMC supports a strategy to manage congestion and mobility in five boroughs using traffic control software that apply traffic patterns suitable for peak periods, special events, and emergencies in the City. The TMC is the primary point of coordination for managing transportation resources within an agency and among other local and regional agencies.

Over the years, the NYC DOT has transformed itself as it has moved into a multimodal environment. It has joined hands with the co-located New York City Police Department (NYPD) TMC on a 24/7 basis. The institutional cooperation achieved between units of the City government is improving as common interests and mutual benefits are becoming apparent. A dedicated Emergency Response Center (ERC), a major unit of the NYCDOT, handles internal and external communication functions to manage incidents and coordination. The NYCDOT TMC is supported by these centers, which maintains radio communications with field units on a 24/7 basis, including incident management. The coordination of highway operations in the City is carried out jointly by the NYCDOT and the NYSDOT Region-11 Joint Transportation Operation Center (JTOC) located adjacent to the NYCDOT TMC. This sharing of the joint operations is the result of the Memorandum of Understanding between the two agencies and jurisdictions (i.e. New York State owns state highways in the New York City region; however highway operations and maintenance rests with the NYC DOT).

6.1 An Overview of the NYCDOT TMC Operations

This chapter discusses the role of the NYCDOT TMC in ITS deployment throughout the City. The City of New York has established a fully integrated advanced transportation system which moves over one million vehicles and over five million commuters on surface streets each day. From the TMC, traffic engineers can monitor traffic conditions and make on-line signal timing changes, modify database parameters, and perform system optimization. A Central element of these TMC operational capabilities lies in the City's Vehicular Traffic Control System (VTCS), which consisting of 11,600 traffic signals. Of those, 6,000 traffic signals are under computer on-line control in all five boroughs.

All 2,650 traffic signals in Manhattan are interconnected thru a coaxial cable network owned by the City and deployed at a high rate of 56,000 bits/sec data channels. An additional 2,200 traffic signals in the Bronx, Brooklyn and Queens will be added to computer control in the next several years. In addition, VTCS operations are supported by the *Computer Aided Tracking System (CATS)* which provides graphical display of traffic intersections, incidents, permits, cable plant, signals, and planned events, and a flow model. The *Motorist Information Communication Environment (MICE)* system logs incidents and tracks their progress.

The TMC operates the City's variable message signs which have been installed on major highways at selected intersections. The NYC TMC was designed to maximize operational efficiency and support for maintenance activity. Projection graphics and video monitoring capabilities allow traffic engineers the capability to assess traffic congestion and incidents in Manhattan (including bridges and tunnels). Specially designed maintenance workstations allow electricians and field personnel to monitor communications channels and intersection layouts in real-time, and to take appropriate remedial actions, thus keeping system down time to a minimum.

6.2 NYCTMC System Operations

The NYCDOT TMC currently operates and utilizes the following system components for traffic management and coordination:

- Advanced Traffic Management System (ATMS), including the Vehicular Traffic Control System (VTCS)
- Advanced Traveler Information System (ATIS)
- Computer Aided Tracking System (CATS)
- Motorist Interchange Communication Environment (MICE)
- Manhattan Coaxial Cable Plant Maintenance System
- TRANSCOM's Regional Architecture Workstation (RA)
- TRANSCOM's Interagency Regional Video Network
- TRANSMIT System Applications in the City (i.e. Flow Maps)
- Information Exchange Network (i.e. I-95 Corridor coalition)
- NYSDOT JTOC ATMS Video System
- Integrated Incident Management System (IIMS)
- Freeway Management Systems (FMS)

The **Vehicular Traffic Control System (VTCS)** is the surface street traffic control system that allows intersection control from the TMC. It also maintains local control in the event of a loss of communications. Traffic engineers can make online signal timing changes, change database parameters, and perform system optimization from the TMC. This home-grown system utilizes a open system minicomputers platform. The City owned coaxial cable plant connects Manhattan's 2650 traffic controllers to the TMC while other parts of the City currently rely on leased telephone circuits. The NYCDOT is currently exploring possibilities of using a wireless medium for its traffic control communications needs.

Advanced Traveler information System (ATIS)

One of the highly successful tasks performed by the TMC is its ability to provide real-time video images to the travelers under the Advanced Traveler Information System (ATIS) of the New York City Department of Transportation (DOT) at www.nyctmc.org (Ref.2). ATIS serves NYC residents by helping them get quickly through their everyday commute. Twenty-two of NYCDOT's traffic cameras, showing live traffic conditions at major locations, now can be seen on City Drive Live on NYC TV (http://www.nyc.gov./html/nyctv/html/home/home.shtml), the television network of the City of New York, on Channel 74 seven days a week from 5:00 to 9:00 AM and again in the afternoon from 3:30 to 7:00 PM. Visitors to the DOT web pages (Ref.2) also can access these cameras to view real-time traffic movements.

Regional Coordination Systems

TRANSMIT, RA, IRVIN, and IEN are regional ITS systems available to the NYCTMC for regional coordination that may impact other agency operations in the tri-state areas. (Ref.9)

Regional Architecture (RA)

TRANSCOM's Regional Architecture Integrates member agency's ITS, allowing for the electronic sharing of information among the agency's operations centers by ensuring coordination and integration of advanced transportation management and information systems implemented by the 16 member agencies (including NYCDOT and NYSDOT systems). The TRANSCOM Regional Architecture enables the dissemination of real-time information from these systems, thereby optimizing the benefits of Intelligent Transportation Systems (ITS) on a regional basis. The Regional Architecture consists of a central database server linked with workstations located at member agency's facilities. Information shared through this network includes incident and construction data, variable message signs, highway advisory radio, closed-circuit television information, and real-time traffic and transit conditions.

TRANSCOM System for Managing Incident and Traffic (TRANSMIT)

TRANSMIT uses vehicles equipped with electronic toll-collection tags as anonymous probes for transportation management and traveler information. Transponder readers installed along roadways detect EZ-Pass tags and scramble tag ID's for privacy. As tags are detected by successive readers, the TRANSMIT system compiles aggregate data on average speeds, travel times, and the number of non-arriving vehicles (expected vehicles not yet detected by the next reader downstream). By comparing this information to historical data, TRANSMIT can detect incidents and alert the member agency's operations centers for response. Further, information on travel times between key points is an important tool for decision-making by travelers, and is already being provided to the public on a limited basis via variable message signs. Travel times will also be included in the Trips123 traveler information services.

TRANSMIT has been implemented on over 100 miles of toll and non-toll roadways in Rockland, Westchester, Bronx, Kings, Queens, and Richmond in New York; Bergen, Hudson, Middlesex, and Union counties in New Jersey.

Interagency Remote Video Network (IRVN)

The Interagency Remote Video Network (IRVN) is a digital video network connecting 13 ***TRANS****COM* member agency's Traffic Operations Centers (TOC) by allowing the sharing of video feeds. This provides the agencies an ability to view incidents on a neighboring agency's facility, and to determine the impact of an incident. This will be done through a control workstation. IRVN has approximately 270 video feeds on its network viewing facilities in the NY/NJ/CT region.

Information Exchange Network (IEN)

The IEN provides the exchange of data similar to that handled by the ***TRANS**COM* Regional Architecture, but on a corridor-wide basis from Maine to Virginia. IEN applications are useful during major events and emergencies in the corridor, and during area wide transit and aviation disruptions.

6.3 September 11th Emergency TMC Response

In response to the September 11th, 2001 terrorist attacks on New York City, the NYCTMC provided a range of traffic engineering services such as diversion of traffic, evacuation of a large number of people, reversing highways and streets, large size rescue vehicles, and live pictures of the city's infrastructure. The TMC kept the surface transportation system functional on a 24 hours basis and even manufactured special signs for field operation and other help. The entire metropolitan region was mobilized at unprecedented levels. In light of such valuable services provided during the large scale emergencies, many reputable professional circles have been advocated a redefined role of TMC's that will also serve urban areas for evacuation and diversion purposes. Many agencies are also considering plans for disaster recovery centers located far away from central business districts to protect operations from attacks and damages. (Ref.10)

6.3.1 Immediate Response from the TMC

- Updated all VMS signs to "Avoid Lower Manhattan" message
- Shared Video feeds with NYPD
- Monitored highways and streets for emergency access
- Implemented "outbound" traffic signal patterns (direct traffic away from the CBDs)
- Provide traffic reports to emergency service agencies.

6.3.2 TMC Short Term Response

- Coordinated roadways conditions with other regional transportation operators through TRANSCOM and direct communications
- Coordinated with NYSDOT Operations Division Personnel to arrange for heavy construction equipment for rescue efforts
- Continue to monitor highway and streets to help rescue efforts
- Provide "real-time" traffic reports to emergency service agencies

6.3.3 DOT Traffic Engineering Response

- DOT traffic engineering personnel were engaged in variety of activities to meet unforeseen conditions and unexpected needs such as reversing streets, mass movements of buses and rescue vehicles of all sizes, and transporting workers to rescue sites and staging areas. Such extraordinary needs presented challenges to traffic engineers. The following is a list of activities carried out on a 24 hours basis(Ref.10):
- Extension of Rush Hour Traffic Patterns
- Reverse Progressions at vehicular check points
- Street Direction changes
- Creation of Bus Only Streets
- Creation of Emergency Lanes on Limited Access Highways
- Implementation of Additional Ferry Service
- HOV restrictions on AM Rush Hour Entry into Manhattan
- Monitoring and reporting on "real-time" traffic conditions to NYPD and media
- Relocated Portable VMS signs and updated messages to reflect "new" traffic regulations

6.4 Typical TMC Functions

The following high-level functions are typically performed by the TMC:

- Day To Day Communications & Information Exchange
- Evacuation Plan (used during major fires, flooding, hurricane, earthquake etc.)

- Route Diversion (mass movement of people and emergency rescue vehicles movement)
- Congestion Management
- Transit Information
- Incident Management (detection, verification, management and data analysis)
- Traffic Signal Control & Coordination
- Construction Management and Work Zone Coordination
- Travel Information Dissemination
- Record Keeping
- Internal and External Communication and Coordination
- Staff Training & Drills to support operation Scenarios

Figure-10 NYC TMC Engineer Monitoring Key Locations

6.5 Coordination between Regional Traffic Management Centers

NYCDOT's Long Island City facility as shown in Figure-10 houses a centralized command center for citywide traffic operations. The TMC remotely controls the traffic signalization system, traffic monitoring cameras, and 23 Variable Message Signs (VMS). NYPD's Traffic Operations Center is also based at the TMC, and it allows for close interagency cooperation including joint monitoring of the TMC's multiple Closed Circuit TV screens to facilitate rapid deployment of respective resources to incident areas. NYSDOT's traffic management center is also located at the same facility.

Implementation

In addition to the TMC's ongoing functions, NYCDOT, NYPD and NYSDOT are working together to take advantage of CCTV's, radar detectors and other ITS monitoring devices along state highways. The following technological resources are being shared at the Cross Bronx Expressway, the Bruckner Expressway (interchange reconstruction project), Van Wyck Expressway, Gowanus and Prospect Expressways, and the Long Island Expressway (reconstruction project):

- 255 CCTV cameras
- 38 fixed and 10 portable VMS
- 180 radar detectors
- 20 classification detectors
- 5 HAR antennas
- 43 Video Incident Detection System cameras
- 17 miles of fiber optic cable

6.6 Increase Driver Awareness of Congestion Using HAR/VMS Systems

Use of Highway Advisory Radio (HAR) and placement of VMS on streets leading up to bridge and tunnel gateways, major arterial intersections, highway interchanges and other key locations has resulted in a qualitative increased information dissemination to motorists. Radio messages and signs inform motorists of real-time traffic conditions, major construction areas and alternate routes.

DOT maintains an inventory of 23 fixed and portable VMS, most of which are located to provide route guidance to users of the East River Bridges. The NYPD has a current inventory of 9 portable VMS for use throughout the City at traffic emergencies to inform and redirect motorists, and to reduce speeds at accident prone locations. In nearly all cases, messages are controlled remotely from the TMC. Regional transportation agencies (MTA, PA, NYSDOT, NJDOT, NJ Highway Authority, NJ Turnpike, and the NYS Thruway) maintain separate VMS inventories of 24, 28, 25, 40, 30, 10, and 4, respectively. Several regional agencies (PA, NYSDOT, NJDOT, NJ Highway Authority, NJ Turnpike, NYS Thruway) also maintain HAR stations to advise motorists of conditions (4, 4, 7, 1, 5 and 15 stations, respectively). A high level of cooperation and coordination exists between all agencies. Working with TRANSCOM, "gridlock alert" advisories and "DON'T BLOCK THE BOX" are disseminated as needed.

6.7 Expand Usage of NYCDOT Traffic Monitoring Cameras

The TMC can receive images from 255 cameras located on the Queensboro and Williamsburg Bridges, Long Island Expressway, Gowanus/Brooklyn Queens Expressway, Staten Island Expressway, West Shore Expressway, Belt Parkway, Grand Central Parkway/Shea Stadium, the Van Wyck Expressway, and major Manhattan intersections. This includes an interim FDR surveillance program (which utilizes the Manhattan Traffic Signal System infrastructure) at Pike Slip, Brooklyn Bridge, Grand Street, 23rd, 36th, 78th, 96th, 125th, and 155th Streets. An installation of a receiving dish on the roof of the facility to receive "line of sight" images will further expand monitoring capability. Employing this advanced technology, we anticipate receiving video images from the Cross Island Parkway and sections of the FDR Drive currently inaccessible from the Manhattan Cable Plant System.

In conjunction with NYS DOT and NYPD, the Integrated Incident Management System (IIMS) project has begun operations on most highways within the city. This project allows first responders to electronically send "real-time" images of incidents directly back to the TMC. The information received at the TMC is then shared electronically with other response agencies that have an interest in the incident. This ability allows DOT, along with other response agencies, to more intelligently make response decisions reducing the overall time duration of incidents.

Event/Incident Response – DOT has developed signal timing response scenarios for planned (e.g., NYC Marathon, parades, etc.), predictable (e.g., Yankee & Shea Stadium traffic, etc.), and unpredictable highway incidents and accidents.

Rapid Response – NYPD supervisors at the TMC direct rapid responses to traffic emergencies as they arise.

Improved Information Dissemination: Currently DOT has agreements in place with two monitoring networks (Metro Channel 12 and Metro Commute) to share real-time traffic information. Both firms have provided the necessary hardware and communications linkages to receive images from traffic monitoring cameras. In addition, DOT continues its partnership with city owned and operated NYC TV to help produce the "City Drive Live" television program. The program airs during both the morning and evening peak periods. The program is intended to provide drivers with "real-time" traffic images from our existing traffic surveillance cameras. Cameras from each of the five boroughs are included. A total of 30 cameras are currently utilized in the program.

Exporting Video Images to the Worldwide Web – Real-time traffic video images were first made available on DOT's website in December, 2000. The area of coverage has since been expanded and users now have the option of selecting images from 101 cameras; 46 on local Manhattan streets and 55 from key limited-access arterials (12 from the Bronx, 18 from Brooklyn, 21 from Queens, and 4 from Staten Island). 30 of the 101cameras offer a live, "streaming video" option.

6.8 Emergency Response Plan

On major incidents that require evacuation of an area in the City, TMC staff will perform the following Tasks:

- **Notification:** TMC staff will notify the following managers and executives:
    - TMC Management, Director of Engineering, Signal Duty Officer,
    - Deputy Commissioner of Traffic Operation
    - First Deputy Commissioner
- **TMC Staffing:**
    - TMC Manager on 24 hour Call will report to TMC.
    - Increase the number of TMC staff and Extend their working hours
- **Coordination:**
    - Communicate and Coordinate with NYCDOT Emergency response, PD and OEM on plan formulation, needed response, implementation, and support.
- **Special Incident Report:**
    - TMC staff will create a special incident report that documents events, requests, responses, and tasks

6.9 TMC ITS Mobilization

Variable Message Signs

- Immediately post appropriate message.
- Coordinate with NYCPD, NYSDOT and TRANSCOM for messages on VMS's not owned by NYCDOT.
- On VMS's with no available communications, contact 'Signal Inspection' (a unit of NYCDOT) to download appropriate messages. Update messages as needed.

Computerized VTCS Intersections

- Immediately implement appropriate traffic signal timing patterns.
- Provide a list of all "communication failures" to the New York City Police Department (NYPD) and ask for manual presence at intersection until we can either manually adjust the timing using personnel from Signal Inspection, Signal Timing, and/or Signal Maintenance Contractors.
- Monitor available video images and field reports, and adjust signal timing as appropriate.
- Monitor VTCS for intersections that "fall off-line" or lose communication, and dispatch field personnel to correct problems. Also notify the NYPD for additional coverage if necessary.

Non Computerized Intersections

- If necessary, have Signal Inspection or Signal Timing implement simple "progression" patterns.

Construction

- Emergency Response Center (ERC) will contact all agency construction and maintenance crews (Bridges and Highways) via an agency radio system or via Nextel to cease work (where appropriate)
- In worst case scenario broadcast message over the radio instructing all work to cease on appropriate roadways
- ERC should contact private sector to cease work

Traffic Surveillance Cameras and Flow Maps

- TMC personnel to monitor all available cameras and electronic flow maps to monitor the impact on traffic flow, and will share information with the ERC and NYPD.

- Create appropriate "**Traffic Conditions Report**" and update periodically depending on the situation. Updates are to be distributed throughout the agency and the NYPD and the Office of Emergency Management (OEM).

Parking

- Have Parking Control Unit (UNIT) Officers and Tow Trucks available and deployed as needed.

Communication Redundancy Available to the NYCTMC

- Direct Links from Center to Center (DOT)
- Telephone
- Landline
- Cellular
- Nextel
- Fax
- Web Based
- DOT NET
- Internet
- Blackberry
- IIMS System
- TRANSCOM Regional Architecture

6.10 NYCDOT Traffic Management Center Tasks

The NYCDOT TMC operators are charged to perform the following specific tasks:

- Monitor "real-time" traffic video surveillance cameras, alerting the situation room and/or other agencies in the event of an incident that requires their attention. Also, provide periodic status updates to all affected parties. Also, prepare necessary forms for dissemination to the situation room as part of the agency's DOTMOVE program.
- Operate the VTCS system, the Manhattan display map, and the MOSYS Variable Message Sign (VMS) System.
- Check the status of VMS signs and traffic surveillance cameras, and prepare daily maintenance reports. Prepare daily activity report.
- Manually check the operating status of the computerized traffic signal timing plans.
- Implement changes in traffic signal timing or Variable Message Sign legends in response to an incident.
- Interact with the NYCDOT Manhattan signal and cable maintenance crews via Radio Frequency assisting them in the following functions:
- Monitor RF signal levels using the VTCS system and the Manhattan display map and assist to identify causes and potential solutions to problems
- Provide crews with necessary manhole and NYCDOT permit numbers
- Assist in troubleshooting Manhattan traffic signal failures. This requires the review of event logs and/or verifying traffic signal timing specifics such as offsets and breakouts.
- Prepare intersection repair orders and assist the contractor through radio communication in troubleshooting traffic signal intersection failures in boroughs other than Manhattan.
- Monitor all computer systems and perform initial repair when necessary.
- Coordinate with other TMC's, including NYPD TMC, and JTOC.
- Coordinate within agency, and coordinate with other City agencies when necessary.
- Provide input and feedback to the ITS deployment efforts.

Chapter 7 ITS Research, Training and Education Support

7.0 Coordinated ITS Deployment in New York City (CIDNY)

The Coordinated ITS Deployment in New York (CIDNY) project, sponsored by the NYCDOT, NYSDOT, and FHWA created the Urban ITS Center (UITSC) at the Polytechnic University. Under a multi-year contract with the New York City Department of Transportation and the New York State Department of Transportation, the UITSC, as shown in Figure-11, has been acting as a research, development and training arm for both the Departments and other transportation and public safety organizations, for ITS related activities. In this chapter, recently completed and upcoming ITS projects are discussed.

Figure-11 Urban ITC Center (UITSC) Training Class

7.1 CIDNY's Role in Training and Education

The UITSC has created a focused training courses based on user's need and input, and blended with critical aspects of design, operation and standard practices. For example, an introductory Traffic Engineering course was developed to incorporate traffic signal operational principles and safety issues facing traffic engineers. Key aspects of development of training courses offered by the CIDNY project include the following:

- Training courses identify roles and responsibilities of team members and illustrate through exercises why it is important to know each other's roles and responsibilities in managing assigned functions.
- For example, a NYPD staff member knows his/her role in an incident management process, but not fully aware of how the NYCTMC traffic signal timing is controlled and implemented. Capabilities, constraints and limitations are exposed in such a training environment as it helps the team to understand the larger picture.
- Local and regional coordination requirements, procedures and response mechanisms.
- Courses must contribute to Knowledge, Skills, and Abilities (KSAs).
- Training course outlines are developed with input from concerned participants.
- Development of course materials follow generally practiced methods by the National Highway Institute and other USDOT training courses.
- All courses are evaluated by participants and documented.
- Course topics are carefully chosen by operational managers in order to meet current training needs.

7.2 Research and Training Projects Completed by UITSC

The 1999 Framework for a 'Strategic Local Plan for New York City' created significant awareness of ITS in the New York City Department of Transportation. It resulted in an organized training program under the CIDNY project, by establishing a joint venture among Polytechnic University, NYCDOT, and NYSDOT (including FHWA).

Table-5 outlines ITS projects completed by CIDNY under its contract in years one and two. Table-6 outlines proposed ITS projects for Year-3 (January 2005-December 2005).

Table-5 ITS Research and Training Projects Completed Under CIDNY Program

#	Project Title	Project Description
	2002 Projects Completed	
1	Creation Of ITS Lab	Offers professional learning environment, Traffic simulation modeling, training in traffic engineering, and hand-on workshops.
2	Training for TMC Operators	TE 101, IM 101, ITS Introduction
3	Advanced Traveler Information System (ATIS)	Developed web page and provided support for Website – http://nyctmc.org
4	Shea Stadium Parking Information System	Developed study and provided a system design for parking information system.
5	Adaptive control strategy simulation	Developed a Model To Evaluate the Effectiveness of Adaptive Signal Control, Bus Priority, & Emergency Vehicle Preemption
6	East River Bridges O-D Study	Feasibility study of using Electronic Tag Technology for tracking O/D and Vehicle Classification at East River Bridges
7	Detection Technologies for Travel Time Estimation	Evaluated different technologies and their effectiveness.
	2003 Projects Completed	
8	Update the Strategic Local ITS Plan for NYC	To provide initial services to develop an update on 1999 ITS Strategic Plan
9	Enhancement of ITS Lab	Additional software and equipment for the ITS lab were investigated, and necessary training equipment has been purchased. Further enhancements are planned for Phase-II work to connect the lab to NYCTMC.
10	ITS Educational/Training Program	Five Traffic Engineering 101 courses were held in this Phase-I period. Development for the ITS 101 course has been continuing. Other courses have been continuing.
11	Technical Support for NYCDOT's ATIS (*www.nyctmc.org*)	The tasks included the development and installation of additional security features and the creation of a kill switch to immediately close down the images if needed.
12	Developing Requirements for Tabletop Exercises for TMC Staff and Operation	The purpose of this project is to prepare New York City Agency operations staff for emergency traffic management. This project is concerned with the role of surface transportation in emergency management, evacuation, TMC, and traffic management. The project will develop a set of requirements for tabletop exercises to be conducted at later stage.
13	Enhancement of ITS Lab	This project will upgrade existing hardware/software in the ITS Lab and add the communications interface necessary to be able to receive TMC information in real-time. Upon completion of the upgrade, the Lab should be able to develop future research projects that will utilize data, and in the future conduct simulation and train for operators and engineers in real-world situations, and prepare for future

		emergencies.
14	Update ITS Strategic Plan for NYC	The original ITS Strategic Plan developed for NYCDOT is outdated and needs updating to include new direction, projects and sub-regional ITS Architecture requirements in the City. This project will make an amendment to that plan by issuing a supplemental report which will include current policy and program of the NYC DOT ITS deployment
15	NTCIP Testing and Training Support	The purpose of this project is to train NYCDOT and NYSDOT staff in use of NTCIP testing software purchased by FHWA for the training purpose.
16	Introduction to ITS	The purpose of this project is to provide an introduction to ITS for the NYCDOT and NYSDOT, and other public agencies staff. This one day course will allow agencies to deploy basic principals in their projects.
17	Deployment of ITS and Technologies	The purpose of this project is to provide an integrated view of how ITS systems can be deployed and used effectively for transportation management. It will cover systems engineering approach, procumbent issues, software/hardware integration, and expose students to various ITS technologies such as AVL, DSRC, Wireless, GPS/GIS, open systems architecture etc.
18	Technical Support of NYS DOT: TRANSMIT Evaluation	The purpose of this project is to perform an evaluation of the TRANSMIT for NYSDOT in the Bronx.
19	Technical Support of NYS DOT: HELP Evaluation	The purpose of this project is to perform an evaluation of the HELP program for the NYSDOT in Queens.
20	Technical Support of NYC DOT: ATIS Web-site	Enhance Website as per NYCDOT direction

Table-6 ITS Research and Training Projects Proposed Under CIDNY Program

(January 2005-December 2005)

#	Project Title	Project Description
1	Traffic signals inventory database	Develop a PC-based database to include all on line-traffic signals with timing and controller data, and also include on-line computerized signals with signal timing data manually inputted from available DOT sources. This project will allow the executive and operational signal management staff to obtain current information from one-sources and help make operational decisions based on correct information.
2	Demonstration of a real-time congestion management system test-bed	The project will develop a tool-set to measure sensor-based data for real-time assessment of congestion in a selected test-bed area. This tool will be developed by POLY with data received from TMC though fiber cable connection. The tool will be reusable for other test sites, and will allow operation staff at TMC to create appropriate signal timing and regulatory response to meet traffic demand in the area.
3	Traffic Signals Retiming Concept Plan	Develop a short (5 pages) approach to retiming traffic signals, and briefly describe current thinking on retiming and possible funding sources available for such project
4 A	TE 101 Course	Deliver one-day course on TE 101, with minor update.
4 B	ITS Design Course	Incorporate Design of ITS elements and roadside improvements for deployments.
4 C	NTCIP Testing Workshop	Develop test plans and provide hands-on training one time a year for DMS, Traffic controllers and update tool provided by the FHWA.
4 D	ITS/Traffic Management Course	Develop and Deliver ITS/Traffic Management course with operational strategies emphasis
4 E	Traffic Engineering f for NYPD Course	Develop and Deliver a 4 hrs short course for NYPD executive staff. Currently there is a need to educate PD executive staff on the traffic systems, strategy, and coordination issues having impact on traffic flow and enforcement. This course will explain how systems are designed to perform certain functions in the field.
4 F	Introduction to Communications Technologies Course	Develop and Deliver one time a year, an introductory emergency management course that will include terminologies, procedures, coordination needs, external and internal coordination, with FEMA, DHS,OEM.
5	Workshop on Role of ITS in Transportation Security/Emergency Management	A second follow up workshop on how ITS can help NYC agencies in transportation security and EM in the City.
6	Quarterly Tabletop Exercises	Develop and conduct two scenarios-based table exercises for JTOC/TMC staff scheduled at the beginning of each quarter. Limit to daily SOP functions, planned and unplanned events and create knowledge-base.
7	UITSC Website	Develop and Disseminate all documents on UITSC website and link it to POLY and NYCDOT websites and other relevant websites.

Appendix-A 1999 Framework for a Strategic Local ITS Plan

1.0 Brief Description of the 1999 Strategic Plan

In November 1995, the NYCDOT established the Urban ITS Center at Polytechnic University for the purpose of creating an effective mechanism through which the city can work with other agencies and the private sector on matters concerning the deployment of ITS technologies.

The mission of the Urban ITS Center (UITSC) was established as: to promote the use of ITS technologies that enhance the operational efficiency of the City services, better serve customer's travel needs, and improve the quality of life in the City.

The report-***Framework for the Strategic Local ITS Plan for New York City***- was prepared by Urban ITS Center at Polytechnic University. The principal purpose of the project was to develop recommendation for ITS implementation and management policies in New York City with Particular emphasis on the local road network and its interface with the regional multi-modal transportation system.

The main product of this report was the development of eight deployment elements for New York City. These elements created a foundation on which future ITS can be uilt.

The report was presented in three main parts:

Part 1: The Background Setting
Part 2: Local ITS Plan Elements
Part 3: Putting the Local ITS Plan into Action

2.0 The Background Setting

NYCDOT is an active partner and stakeholder in the planning and implementation of the various ITS projects in the New York City area. These ITS projects collectively aim

- To increase mobility and travel safety in New York City,
- To increase the efficiency and effectiveness of the city's multi-modal transportation system, and
- To increase the quality of life of its residents.

The Local ITS Plan considers the various aspects of ITS: implementation, operations, and management. These aspects include funding requirements, funding source, control and management of information, management of the transportation system, and accountability. The Local ITS Plan was developed with the following objective in mind:

- Identify local operational issues than can be improved by ITS deployment
- Develop it as and “overlay” to the regional EDP ITS Strategic Plan
- Build upon the existing institutional and organizational structure of NYCDOT
- Promote the attainment of NYCDOT’s mission, and place NYCDOT in a position to provide better transportation using ITS deployment.

3.0 Local ITS Plan Elements

The Local ITS Plan defines eight specific ITS Plan Elements associated with the City’s multi-modal transportation system and reflect NYCDOT’s mandate:

- Management of Local Streets Parallel to Region or Major Facilities
- CBD Circulation and Curb and Parking Management
- Incident Management at Local Approaches to Bridges and Tunnels
- Integrating Bus Transit into Local Road Traffic
- Advanced Traveler Information Service
- Advanced Pedestrian/Bicyclist Safety Systems
- AVL for Taxi/ Black Car/Limousine Management
- Infrastructure Physical Monitoring and Management

4.0 Putting the Local ITS Plan into Action

This part of the report is divided in three parts

- Development process for implementing the ITS Plan Elements
- Identify ITS deployment issues
- Future of ITS deployment

The development process is geared towards the generation of operational and tactical plans that will focus on ultimate deployment, including the following actions items:

- Define Operational Implementation Scenario
- Develop Organizational Structure/Framework
- Deployment Strategies
- Request for Proposals (RFP’s)
- Pilot Test Candidate Strategies/Technologies
- Evaluate Benefits and Costs of Proposed initiative
- Present to New York City Decision and Policy Makers
- Make Recommendation for Wider-Scale Deployment

Deployment issues relevant to New York City

The following issues were derived from the interviews and meeting with local agencies:

- Interagency Coordination
- Role of the Private Sector
- Potential Funding Sources
- Education and Training of Agency Personnel
- Operation and Maintenance of Implemented Initiative
- Technology Issues and Standards/Protocol
- Public Outreach and Legislative Outreach

Finally the report also focuses on the future steps that NYCDOT needs to take in launching an official, agency-wide ITS deployment program, addressing issues of intra-agency coordination, and organizing it self to pursue interagency coordination in ITS planning and deployment in the NYC region, and how it can obtain immediate technical support to carry out ITS deployment.

5.0 Introduction to Strategic Plan Elements

The strategic plan introduced eight program elements:

Plan Element No. 1:

Management of Local Streets Parallel to Regional or Major Facilities

This Local ITS Plan Element focuses on the important role of pro-active management of the arterial street network, specifically those that are parallel to regional or major highways or limited-access facilities. The primary goal of using ITS to manage local arterials is to protect the limited access/highway network due to congestion.

Pro-active management of the City's arterials will require adequate surveillance of the local street network (and the regional limited-access highway network), control and enforcement of arterial speed, comprehensive traveler advisory system, and sharing of multi-media traffic information among all transportation providers and system managers operating in the New Your City metropolitan region.

Problems and Needs

The Main Issues: Traffic on highways will divert to local streets when major highways become congested. How can NYCDOT manage local arterials and interface with major highways/roadways to minimize the use of local neighborhood streets by through traffic diverting from the regional highway facilities?

ITS application for commercial vehicles aims to streamline the commercial vehicle safety regulatory system and enhanced its effectiveness in the trucking industry. They apply both to truck fleet operators and state regulations. These systems are meant to support a safe and seamless intrastate and interstate transportation system. The ITS program for commercial vehicles comprises the following:

- Electronic clearance
- Automated roadside
- Onboard safety monitoring systems
- Automated administrative process
- Freight mobility system
- Hazardous materials incident response

The focus of this Plan Element is the local roadway system that is not included in the NYC ITS Early Deployment Plan (EDP). The following matrix describes the jurisdictional responsibilities and scope of ITS deployment planning for the regional highway network and the local roadway network:

Agency	Regional Highway Network (Limited-Access and Primary Arterials)	Local Roadway Network (Local Arterials and Neighborhood Streets)
NYCDOT	Addressed in the NYC ITS EDP	Focus of Local ITS Plan
NYSDOT	Addressed in the NYC ITS EDP	N/A

Congestion on the highway and arterial roadway networks in the New York City is a serious economic, environmental, and quality of life problem, to say the least. According to a national study conducted by the Texas Transportation institute (TTI), which quantified urban mobility for 50 Urban areas throughout the U.S., New York City ranks among the highest in the nation in terms of congestion level and the associated waste in fuel consumption-only second to Los Angeles in severity of congestion and its adverse impact on air quality.

In New York City, the motor vehicle (i.e. auto, taxi, van, and truck) account only for about 33% of the modal share of the people entering the central business district of Manhattan on a typical fall business day. This gives the congestion in New York City shift towards the automobile; it could overtake Los Angeles in record-high congestion delay and wasted fuel.

ITS can be utilize to effectuate the pro-active management of the local arterial roadway system and the interface with the regional highway network to protect the city’s neighborhoods from the impact of the severe traffic congestion in New York City.

Plan Element No. 2:

CBD Circulation and Curb and Parking Management

This local ITS Plan Element addresses the traffic and circulation problems of the densest and most congested parts of the city-the busy downtown section and very active commercial districts in all the five boroughs. Key operational issues for the City's CBDs (Central Business District) include the shortage of street capacity to meet increasingly high vehicular demand, managing vehicle/pedestrian conflicts, providing mobility in and around the CBDs, ensuring accessibility to business and commercial destinations, and accommodating goods movement and service delivery.

Traffic flow and circulation in the CBDs are greatly impacted by how various drivers use (or violate the use of) the critical curb lanes in these busy areas, strict enforcement of restricted curb lane, on-street parking, and commercial curb loading regulation is a critical element in ensuring mobility and accessibility in the CBDs. ITS technologies are available that can help improve the enforcement of these critical traffic and parking regulations; also available are advanced driver information services and circulation/parking management systems that can rationalize the movement of vehicles within CBDs.

Problems and Needs:

In spite of the available transit services to the CBDs in New York City, a significant number of people decide to drive there for various reasons. The reasons for not using transit seem to be similar for work and non-work trips and for male and female drivers, according to a recent study sponsored by the NYCDOT.

The search for parking has been demonstrated to produce considerable amount of added vehicle-miles-traveled (VMT) in New York City. This increased VMT adds to already serious traffic congestion and its negative impacts on transportation mobility, safety and air quality.

"The Vehicle Mile of Travel (VMT) generated while looking for a parking space for periods longer than 5 minutes, may be regarded as surcharge VMT which adds to CBD traffic congestion. The amount of congestion added to the street system solely due to the additional VMT accumulates while searching for a parking space can be significant."

In Europe, parking management systems are deployed to inform drivers about the location of available parking space in order to reduce the time spend looking for a parking space during busy peak periods. "the systems therefore reduce congestion; it has been estimated that up to 30% of traffic in a city center is made up of vehicle looking for parking spaces, and that a (parking management) system can save each driver an average of six minutes per trip."

The effectiveness of curb lane regulation measures depends on the level and frequency of enforcement; and too often, enforcement needs exceed the human resources dedicated to the enforcement effort. In addiction, effective traffic enforcement is very expensive and is often subject to varying priorities depending on available resources and current needs. But when traffic enforcement activities are not adequate, the number of blockage of restricted-use curb lanes increases, resulting in a deterioration of traffic conditions. There is a need to improve curb lane monitoring and management that would increase the efficiency of the local street network and improve mobility and safety by reducing congestion and traffic conflicts.

"Currently the use of curb space by commercial vehicles creates additional traffic congestion not only by searching for a parking spot but also because of the double parking practice." The management for of commercial vehicle space could be implemented with a pricing scheme that would encourage truck driver to minimize their use of these spaces and with the application of ITS technology through electronic payment services. Potentially more curb space could be made available to arriving commercial vehicles when the commercial curb space is metered efficiently.

Plan Element No. 3:

Incident Management at Local Approaches to Bridges and Tunnels

This local ITS Plan Element is envisioned to address the severe impact of traffic-related and other incident at critical choke in the roadway network-the City's bridges and tunnels which serve as "portals" to the city. By focusing NYCDOT's effort on incident and emergency management on these crucial nodes of the roadway network, NYCDOT will positively impact the flow of traffic in the city and the rest of the metropolitan region.

"Incident management provides a solution to the problem of congestion by reducing the impact of incident on traffic. Incident management consists of mare rapid detection, response, and clearance of an incident as well as effort to spread information about an incident to encourage driver to seek alternate routes and to reduce traffic building in the queue."

Problems and Needs

National studies show that about 60% of all congestion on the limited access roadway network is incident-related-the result of vehicle breakdown, roadwork, accident, spilled debris, and other traffic incidents. "Every minute an incident remains on the roadway results in an additional five minutes of delay after the incident is cleared. A one lane blockage of a three-lane roadway results in a 50% loss of throughput."

"In many cases, incident delay also has other short-and long-term consequences, including:"

- Loss of time and productivity
- Increase in fuel consumption or Vehicle operation costs
- Decrease in air quality
- Increase in the cost of delivering goods
- Decrease in highway (and roadway) safety; and
- Decrease in a region's economic competitiveness and quality of life

Coordination of information between various respondents, such as police, fire, emergency medical service, highway maintenance, and traveler assistant is of primary importance in incident and emergency management. "Incident management programs include incident detection, verification, scene management, traffic management, and clearance."

Plan Element No. 4:

Integrating Bus Transit into Local Road Traffic

This ITS local Plan Element focuses on the private franchise bus operation which are funded and managed by the NYCDOT, but could also help improve all bus services and impact all bus riders in New York City. Integrating bus transit more efficiently into the local road traffic will require balancing the conflicting needs of many road users who all want their share of the public road right-of-way.

Integrating bus transit operation and traffic management has many facets: tracking buses in real-time and providing this information to the customers, using information on local road traffic condition to adapt service routes to respond to real-time conditions, dispatching buses based on the demand by customers which vary through the day and among routes/service areas, providing some priority treatment to transit vehicles across signalized along major bus routes, and automating the maintenance of bus transit fleets.

Integrating bus transit operation and traffic management also requires sharing of information among different bus services operators and with the riding public, and the use of one compatible inter-operable customer information system that seamless to all bus riders in New York City.

Problems and Needs

Bus riders usually complain of the unreliability of bus transit services. Typical problem cited include bus 'bunching,' low bus speeds, irregular headway or bus spacing, lack of bus arrival information at bus stops, poor time of line transfers, crowding, security, and poor bus maintenance.

The most common problem experienced by the bus passengers is the waiting for the bus and not knowing when the bus is coming, possibly worsened by a fully loaded bus when it arrives. This phenomenon highlights the need to provide customers traveler information along the route in real-time.

A key operational problem faces by bus operators is optimizing the efficiency of its operations, i.e. minimizing cost while maximizing service levels. Bus operators would operate more efficiently if they knew where their buses are and can reply information about operate more efficiently if they knew where their buses are and can relay information about the traffic condition to the drivers. With this communication available, bus operators could raise service levels while utilizing existing recourses optimally.

Bus transit on the local street network has the specific challenge of sharing the public road right-of-way with private cars, for-hire vehicles (both legal and illegal), service delivery vehicles of all types and sizes, and emergency vehicles from a host of public institutions.

Maintaining a bus run schedule on the congested arterial street and collector roads of New York City has been described as impossible by some bus operators. Bus transit service on the local street network could be improved if given some priority treatment through the signalized intersection along major arterial corridors or bus routes.

The reliability of bus transit service is also directly tied to how well the bus fleet is maintained. With large bus fleets, fleet maintenance could be costly and time-consuming. Automating the maintenance of transit vehicles could, in the long run, minimize the maintenance cost and the down time of transit vehicles. In the end, automated maintenance of bus fleets could translate to more efficient operation, improved quality of bus service, and larger rider ship.

In sum, there is a great need to provide customers travel information along the route in the real-time, increase the level of service for surface transit, speed up bus service, achieve more regular headway's increase safety and security at bus stops and on-board buses, and maintain the bus fleets more efficiently.

Plan Element No. 5:

Advanced Traveler Information System

This local ITS Plan Element focuses on advanced traveler information Services or Systems (AITS) that aim to help travelers make better decisions on how, when, where, and if they should make a trip. "Uncertainty is one of the major problems when traveling. By providing accurate information before the journey, pre-trip journey planning can help reduce this uncertainty and help travelers to select the quickest or most efficient mode and /or route. This will result in spreading the demand during off-peak hours and in some cases in the modal shift away from the private car."

Traveler information can be made available through a host of different media, including the internet, interactive information kiosks, telephone, radio, fax, pagers, and cellular phone, among others.

Problems and Needs

Travel information, particularly pre-trip, has been perceived as one of the most important tools to be implemented in the ITS area. The availability of pre-trip traveler information may provide for following benefits:

- Avoiding congested routes
- Reduction of driver's stress
- Better Planning of the trip
- Enhanced safety
- Encouragement of modal shift
- Lower fuel waste in congestion
- Higher Patronage of mass transit/public transportation

The most important feature of travel information is that it needs to be as up-to-date as possible, or else it becomes useless to the user. "Traveler information systems that stay current have been proven to reduce travel times for both local commuters and out-of-town visitors."

Plan Element No. 6:

Advanced Pedestrian/Bicyclist Safety Systems

This local Plan Element addressed the particular travel safety concerns of "vulnerable road users"- i.e. pedestrians, cyclists, and those with very specific safety needs, including the very young and old-who are usually more susceptible to and more likely to be involved in road accidents.

ITS tools that specifically help people who are not traveling in vehicles avoid accidents are based on signalized road crossing facilities and use advanced detection techniques to allow more time to the pedestrian or bicyclist crossing the road. Technologies specifically developed at aid the blind include obstacle location and specialized route guidance. Advanced electronic message/warning signs pro-actively worn drivers of the presence of vulnerable road users, giving them more response time to act accordingly.

Since New York City is a 'Walking' city, the use of ITS technologies and strategies to enhance safety for pedestrian and other non-motorized modes of travel is not only appropriate, but highly desirable.

Problems and Needs

"Nationwide, in 1994, there were 5,600 pedestrian deaths and 65,000 non-fatal injuries caused by motor vehicles. The pedestrian deaths caused by motor vehicles represents13% of all deaths that occurred due to motor vehicle. In New York State, however, pedestrian deaths represent 23.9% of all traffic deaths. For all ages, most accidents occur when crossing between intersections (mid-lock), followed by crossings at the intersection. The 5-14 are group account for 10% of all deaths and 27% of all injuries. In New York City in 1993, there were 284 pedestrian deaths and 15,120 pedestrian injuries due to motor vehicles. 25% of all injuries were to children in the 0-14 are group."

"The security and safety of children attending New York City schools is of paramount importance to all those concerned with this issue: parents, schools, administration, and teachers." In addition the application of advanced technology in traffic safety design would strengthen the safety of pedestrian at school and other pedestrian-sensitive areas. The same can be said about safety of bicyclist in the city.

Plan Element No. 7:

Automatic Vehicle Location (AVL) for Taxi/Black Car/ Limousines Management

This local Plan Element explores the real-time and pro-active management of taxi, black cars and limousines operating in New York City. This mode of transportation is vital to the mobility of

New Yorkers. Improving the management of the fleet will lead to enhance safety for drivers and passengers alike, better service for customers, less congestion on the local roadway network, and more cost-efficient operation by operators.

Taxis, black cars, and limousines provide on-demand transport services that enable individual travelers to request service by specifying destination and any special needs. The use of automatic vehicle location (AVL) system, possibly integrated with complementary systems such as computer-aided dispatch (CAD), will promote the safety of drivers and passengers, improve dispatching and resource management by operators, and enhance the quality of customer service. Moreover, AVL-equipped for-hire vehicles can be used as probes for providing traffic reports/advisories to drivers and as sensors to provide the NYCDOT Traffic Management Center (TMC) with real time traffic data. ITS for demand responsive transport, such as for-hire vehicles, use available off-the-shelf systems and proven technology.

Problems and Needs

For many New York residents, taxis, black cars, and limousines taken together represent a viable alternative for getting around instead of driving and maintaining a personal vehicle. The very high number of these for-hire vehicles and the practice of driving without the benefit of knowing traffic bottlenecks produce high inefficiencies in productivity and poor service quality.

The vehicle-tracking component of AVL system will promote the level of safety and security for taxi/black car/limousines drivers and their passengers. ITS components could be deployed that will instantaneously send warning messages from the vehicle to the control/dispatch center.

With the use of AVL to match demand with supply, taxi drivers could respond to electronic calls from taxi stands more efficiently. As for phone reservations of black cars/limousines, an automated reservation and dispatching system (made possible by an AVL/CAD system) would improve operations. This system will promote improved level of quality of reservation services for customer, reduced operation costs for the operators, and increased transport services efficiency.

Over the long haul, the management of taxi/black car/ limousine fleets using ITS would lead to reduced fuel consumption, reduced vehicle emissions, and reduced congestion in the City.

Plan Element No. 8:

Infrastructure Physical Monitoring and Management

This local Plan Element focuses on the critical role of real-time management of the City's transportation infrastructure in terms of its physical/structural integrity, specifically the city's 770 elevated bridge structures under the management of NYCDOT. The primary goals of employing ITS and advanced technologies to manage the physical/structural integrity of the transportation infrastructure include: to improve the effectiveness of infrastructure maintenance practices, reduce the labor cost required by maintenance, extend the life cycle of the structure, and to generate information that can be used to improve the traffic operational performance of these structures.

“Recent developments in information technologies provide new means for real-time monitoring of transportation infrastructure condition, natural events affecting the road user, and traffic characteristics. The potential use of this technology in infrastructure system management is expected to affect all aspects of infrastructure serviceability and its physical performance. This may lead to major cost saving and improvements of driver safety, traffic flow, user information, emergency response, efficiency of winter maintenance, as well as environmental control and impact assessment.”

Problems and Needs

The “lack of preventive maintenance during previous decades has caught up with New York City’s bridges. Many of the movable bridges are difficult to operate due to age, damage from passing ships and rust. Many are 75 or more years old, and some waterway bridges are approaching or have reached one hundred year of age. Some of the land bridges were built on 1920’s and 30’s.”

NYCDOT needs to identify reliable and cost-effective means for preventive management of the City’s bridges, thereby reducing the needs for corrective maintenance, increasing the life cycle of the structure, and potentially decreasing the cost related to the rehabilitation and reconstruction of the infrastructure. There is a need for real-time remote monitoring of structural performance for effective evaluation of structure integrity, which may also significantly reduce the need and related costs of periodic visual inspections.

Management of winter maintenance operation critically needs some means for monitoring road surface and winter condition, which are required for effective de-icing operation using alternative products to salt in order to reduce corrosion effects and to extend the life cycle of the structure.

APPENDIX-B Regional Intelligent Transportation System Architecture Development for New York City

Implementation Plan

New York City Sub-Regional ITS Architecture

Final Report

February 24, 2004 v11

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New York State Department of Transportation

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Traffic System Services for Traffic & Safety, Preliminary & Final Design Services,

Phases I-VI, Advanced Traffic Management System (ATMS) on Highways

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APPENDIX-C USDOT'S ITS PROGRAM – MAJOR 2004 INITIATIVES

USDOT'S ITS PROGRAM – MAJOR INITIATIVES -2004 (Ref.6)

(http://www.its.dot.gov/initiatives/initiatives.htm)

Introduction

As highway deaths continue to rise (43,000 in 2003) and growing traffic congestion robs Americans of time and money, the U.S. Department of Transportation's (USDOT) Intelligent Transportation Systems (ITS) program is launching a new generation of initiatives aimed at improving transportation safety, relieving congestion and enhancing productivity.

Recognizing the ITS program's accomplishments, the ITS Management Council, which is comprised of senior leadership of the USDOT, conducted a multiyear management review to determine the future of the program. The Council's goal was to identify a limited number of initiatives on which resources could be directed to significantly improve transportation. Upon completion of the review, the Council chose nine major initiatives to comprise the centerpiece of the ITS program. These new initiatives were announced by Assistant Secretary of Transportation for Transportation Policy and Director of Intermodalism Emil Frankel at the 2004 ITS America Annual Meeting. While these initiatives are still under development, this document provides additional detail on each of the initiatives.

Now into its second decade, the USDOT's ITS program will build on previous research and operational tests conducted under the program. A natural evolution, each focuses on a specific outcome, attainable within three to five years, that advances the initiative to its ultimate goal. They are:

1. *Integrated Vehicle Based Safety Systems*
2. *Cooperative Intersection Collision Avoidance Systems*
3. *Next Generation 9-1-1*
4. *Mobility Services for All Americans*
5. *Integrated Corridor Management Systems*
6. *Nationwide Surface Transportation Weather Observation System*
7. *Emergency Transportation Operations*
8. *Universal Electronic Freight Manifest*
9. *Vehicle Infrastructure Integration (VII)*

Each of these ITS technology-based initiatives presents an opportunity to dramatically improve transportation safety and mobility in America. In each, there is a clearly defined federal role as well as involvement and partnership with others in the public and private sectors. Obviously, the completion of these initiatives is dependent on the ultimate passage of the program's reauthorizing legislation and the funding. (Ref.6).

In addition to identifying the nine new initiatives, USDOT's ITS Management Council reaffirmed its commitment to bring five ongoing ITS initiatives to a successful completion:

- Intelligent Vehicle Initiative (IVI)
- 511 Traveler Information
- Wireless Enhanced 9-1-1
- Commercial Vehicle and Information Systems and Networks Deployment (CVISN)
- ITS Architecture Consistency

1. Integrated Vehicle Based Safety Systems

Goal: **All new vehicles would be equipped with advanced driver assistance systems that would help drivers avoid the most common types of deadly crashes.**

Background: About 2.6 million rear-end, road departure or lane change crashes occur each year. Of these, 27,500 crashes (about ¾ of the fatal crashes) result in one or more fatalities. A NHTSA analysis showed that widespread deployment of advanced driver assistance systems addressing rear-end, road departure and lane change collisions could reduce motor vehicle collisions by 17 percent. Integrated systems will be more effective and will provide better threat information from multiple sensors, enabling coordinated warnings to reduce driver distraction.

Approach: This initiative, in partnership with the automotive industry, will build on completed and ongoing IVI field operational tests as well as results from naturalistic-driving studies. It will involve projects and studies that include private passenger vehicles, freight-carrying trucks and transit buses. It will consolidate current information about available countermeasures; perform additional research into integration of the driver-vehicle interface (DVI); develop objective tests and criteria for performance of systems that simultaneously address these three types of crash; and design appropriate data acquisition systems. There is an extensive body of knowledge on countermeasures for addressing each of these three types of crash unilaterally; this initiative will be the first attempt to fully integrate these individual solutions. This research will assimilate existing research results and state-of-the-art commercial products and product performance for all systems that are related to this problem.

Milestone: Integrated vehicle based systems that address multiple crash types will be developed, tested and evaluated.

2. Cooperative Intersection Collision Avoidance Systems

Goal: To achieve deployment of intersection collision avoidance systems that can save lives and prevent injuries at 15% of the most hazardous signalized intersections nationally, with in-vehicle support in 50% of the vehicle fleet, by 2015.

Background: In 2002, more than 9,000 Americans died and roughly 1.5 million Americans were injured in intersection related crashes. Intelligent intersection systems can help drivers avoid crashes at intersections. They can be vehicle-based, infrastructure-only or infrastructure-vehicle cooperative. Vehicle-based systems incorporate sensors, processors and driver interfaces within each vehicle. Infrastructure-only systems rely on roadside sensors and processors to detect vehicles and identify hazards and then utilize signals or other methods to communicate warnings of potential crashes to motorists. Infrastructure-only deployments also require data processing techniques, a necessary evolutionary step towards deployment of subsequent cooperative systems enabled by Vehicle Infrastructure Integration (VII). Infrastructure-vehicle cooperative systems will utilize roadside detection and processing systems as developed and refined by infrastructure-only efforts, and will also have a communications system, like Dedicated Short Range Communications (DSRC), to communicate warnings and data directly to drivers in vehicles equipped to receive and display the warnings inside the vehicle.

Approach: This initiative builds on research and operational tests conducted under USDOT's Intelligent Vehicle Initiative. Vehicle Infrastructure Integration will provide the enabling communication capability necessary for cooperative crash avoidance systems, thus VII and this program will be closely coordinated. In partnership with the automotive manufacturers and State and local departments of transportation, this initiative will pursue an optimized combination of autonomous-vehicle, autonomous-infrastructure and cooperative communication systems that potentially address the full set of intersection crash problems, culminating in a series of coordinated field operational tests. The field operational tests will also help achieve a solid understanding of safety benefits and user acceptance.

Milestones: Commercially deployable intersection collision avoidance systems will be developed.

3. Next Generation 911

Goal: Establish the foundation for public emergency services in a wireless mobile society and enable enhanced 9-1-1 with any communication device.

Background: America's current 9-1-1 system cannot handle the text, data, images and video that are increasingly common in personal communications and critical to future transportation safety and mobility advances. A fundamental reexamination of the technological approach to 9-1-1 is essential as the public safety emergency network struggles to accommodate the challenges of wireless communications.

Approach: Leveraging work from the Secretary of Transportation's E9-1-1 Initiative and on-going stakeholder activities, the first phase will determine operational policies and user requirements for an Internet/multimedia-capable 9-1-1 system. In partnership with the 9-1-1 community and the private sector, this initiative will establish call center requirements, operational policies and standards and increase public and industry awareness of the implementation issues by FY 05. During its second phase, the next generation 9-1-1 system will be defined. By FY 07, the initiative will describe and document the framework to enable common devices (cell phones, PDAs, computers, and others) to communicate effectively with 9-1-1 call centers.

Milestones: A national framework and deployment plan for the Next Generation 9-1-1 System will be developed.

4. Mobility Services for All Americans

Goal: **Improved transportation services for the elderly and disadvantaged**. Increased mobility, accessibility and ridership will be achieved by integrating transportation services, via ITS transit technologies, and extending transit service partnerships beyond the health and human service community to other federal funding agencies.

Background: A 2003 General Accounting Office (GAO) report (GAO-030698T) found that federally funded transportation services for the "transportation disadvantaged" are spread among 62 federal programs and are inefficient, duplicative and expensive. Human services transportation is often fragmented, resulting in service area gaps or limited service area due to an absence in trip transfers between transportation providers. Often, customers have to contact multiple case workers for multiple funding programs, scheduled trip times are inconvenient, pick-up wait times and travel times are long and accessibility to transit is limited for seniors and persons with disabilities.

Approach: This initiative builds on the Department's United We Ride program to build a fully coordinated human service transportation system in partnership with health and human services agencies and transit providers. Several ITS technologies will be applied and examined, including (but not limited to): geographic information systems (GIS), integrated vehicle dispatching and scheduling, automatic vehicle location (AVL), communications systems, electronic payment systems / financial tracking and billing systems and advanced traveler information systems (ATIS). Following the technology assessment and operational test phases, a replicable traveler management coordination center architecture or overall design, which will provide one-stop customer-based travel information and trip planning services, will be demonstrated.

Milestones: A replicable model traveler management coordination center will be established.

5. Integrated Corridor Management Systems

Goal: A model corridor management system will be developed to demonstrate how ITS technologies can efficiently and proactively manage the movement of people and goods in major transportation corridors within and between large metropolitan areas. The model corridor management system will demonstrate how proven and promising ITS technologies can be used to improve mobility and productivity in these corridors.

Background: Congestion continues to grow, particularly in major metropolitan areas, and is concentrated in critical corridors that link activity centers and carry high volumes of people and goods. Despite availability of a wide array of proven transportation management tools, a focus on more effective, integrated corridor management has not naturally emerged. Significant unused corridor capacity often exists on parallel routes and facilities, in the non-peak direction on freeways and arterials, within single occupant vehicles and on transit services. The ability to shift travel demands between facilities and modes during traffic incidents, roadway work zones, adverse weather or simply unusually large traffic demands is severely hampered by lack of information. Improving movement through these critical corridors could reduce travel time and delays and increase reliability and predictability of travel.

Approach: This initiative builds on many individual tools already developed, including: ITS applications for integrated Bus Rapid Transit, freeway ramp metering and adaptive control strategies. Key to managing corridors is achieving integration among the services that agencies provide; unprecedented collaboration and coordination between the operator and planning communities are required. This initiative, in partnership with State and local governments, will: pull together ongoing, nearly completed and planned work into a proactive corridor management focus; identify and close key knowledge gaps; and design and implement a major model deployment and other technology transfer activities that will give the transportation community the information and tools it needs to make investments in this area.

Milestones: A suite of tools to support integrated, proactive corridor management will have been developed, applied and evaluated in a model deployment and made available for the transportation community to use.

6. Nationwide Surface Transportation Weather Observation System

Goal: Reduce the impact of adverse weather for all road users and operators by designing and initiating deployment of a nationwide, integrated road weather observational network and data management system.

Background: State Departments of Transportation (DOTs) have invested in Road Weather Information Systems (RWIS) for years, primarily in support of winter maintenance activities. While over 2,000 sensor stations are deployed along America's highways today, their utilization is insufficient to support full-scale operations. The deficiencies can be traced to a number of technical and institutional barriers to the sharing of data collected at these stations. There is a need for a focused, national effort to build this road weather network to provide timely and accurate information to help operate the roadways.

Approach: This initiative builds on the developing partnership with the National Oceanic and Atmospheric Administration and development of the 2002 Weather Information for Surface Transportation plan. Deploying this road weather observational network requires a multi-year effort to build consensus across the transportation and weather communities to design, build, test and evaluate the system components. A number of steps will have to be undertaken to: establish an interagency coordinating committee consisting of FHWA, NOAA, State DOTs, academia and the private sector to oversee the conceptual design and monitor progress; complete ongoing projects related to the initiative such as siting and communication; demonstrating the system for a multi-state, multi-disciplinary region, including verification and validation of siting guidelines, NTCIP standards, etc.; explore linkages to other databases, including other weather (mobile, remote – e.g., satellite), traffic, road composition and road treatment data; revise system design based on findings of demonstration and the previous effort to explore linkages with other databases; develop guidance and standards to enable deployment by others, including full software documentation; refine strategy to transition the system to sustainable operations; and work with the interagency coordinating committee to transition to operations.

Milestones: Demonstration of regional Observation Network; partnership is established to deploy a national observation network

7. Emergency Transportation Operations

Goal: Effective management of all forms of transportation emergencies through the application of ITS resulting in faster and better prepared responses to major incidents; shorter incident durations; quicker, more accurate and better-prepared hazmat responses.

Background: The US averages three tropical storms, one hurricane, 1,200 tornadoes and over 15,000 highway hazmat incidents each year, of which 400 are categorized as "serious," and require an evacuation. These, plus winter weather, wild fires, complex multi-vehicle crashes and potential terrorist attacks, require America to be prepared for any eventuality. Transportation is always involved and is the means by which responders reach the scene, by which victims depart the danger zone and over which recovery resources are delivered. Aggressively managed transportation using ITS is critical to response and recovery from incidents.

Approach: Building on the ITS program's incident management efforts, the USDOT's initiative is designed to assist responders in verifying the nature of a problem, identifying the appropriate response and getting the correct equipment and personnel resources to the scene quickly and safely. The initiative, in partnership with the public safety community and State and local departments of transportation, will address providing effective traveler information during major disasters, planning and managing major incidents involving evacuation, getting ITS operational quickly after a disaster and using ITS to monitor travel conditions on alternate and evacuation routes. It will utilize vehicles themselves to provide the essential data about the incident and transportation conditions on all routes throughout the impacted region, and will make travelers' vehicles capable of receiving important information. Developing and evaluating the standards necessary to accomplish integration of emergency operations are also included in this initiative.

Milestones: A comprehensive set of tools and strategies for improved response and recovery to major incidents will be developed and deployable.

8. Universal Electronic Freight Manifest

Goal: **Improved operational efficiency and productivity of the transportation system through the implementation of a common electronic freight manifest.**

Background: International trade is 25% of America's GDP and growing. Freight volumes by 2020 are forecasted to increase by 70% from 1998 totals, and freight volumes through primary gateway ports could more than double. Improvements in speed, accuracy and visibility of information transfer in a freight exchange could reap large rewards for America's economic vitality. This initiative directly targets that information exchange.

Approach: This initiative builds on ITS freight operational tests, including the USDOT's Electronic Supply Chain Manifest (ESCM). The ECSM focused on one domestic truck-air-truck supply chain, which finished its initial phase in 2002 and demonstrated a cost saving of $1.50-$3.50 per shipment, due mostly to time savings. The electronic manifest effort will be advanced to the next stage by conducting an international supply chain deployment test of the technology and business case elements. It has the potential of pushing paper out of the system of information transfer among the supply chain elements (e.g., manufacturer, shipper, freight forwarder to air carriers). Work to date has been focused on truck-air freight interface. Should implementation of an electronic manifest in the truck-air interface be successful, the next steps would build on this and move it to a Universal Electronic Freight Manifest that encompasses other modal interfaces (i.e. truck-truck, truck-rail, rail-sea and truck-sea). In partnership with shippers and carriers, effort will be directed at clearing institutional barriers and demonstrating the way ahead through standardization, building public/private partnerships that showcase operational improvements and identifying criteria that move the industry toward implementation of this freight technology and associated operational practices.

Milestones: Architecture for the Universal Electronic Freight Manifest will be developed and tested for the international truck-air freight supply chain.

9. Vehicle Infrastructure Integration (VII)

Goal: **Achieve nationwide deployment of a communications infrastructure on the roadways and in all production vehicles and to enable a number of key safety and operational services that would take advantage of this capability.**

Background: VII builds on the availability of advanced vehicle safety systems developed under the IVI and the availability of radio spectrum at 5.9GHZ recently approved by the FCC for Dedicated Short Range Communications. The VII would enable deployment of advanced vehicle-vehicle and vehicle-infrastructure communications that could keep vehicles from leaving the road and enhance their safe movement through intersections. These deadly roadway scenarios account for 32,000 of the 43,000 deaths annually on America's highways.

Approach: This initiative builds on the research and operational tests conducted under the Department's Intelligent Vehicle Initiative. Vehicle manufacturers would install the technology in all new vehicles, beginning at a particular model year, to achieve the safety and mobility benefits while, at the same time, the federal/state/local transportation agencies would facilitate installation of the roadside communications infrastructure. Vehicles would serve as data collectors, transmitting traffic and road condition information from every major road within the transportation network. Access to this information will allow transportation agencies to implement active strategies to relieve congestion. In addition to these direct benefits to the traveling public and the operators of the transportation network, the automotive companies view VII as an opportunity to develop new businesses to serve their customers. To determine the feasibility and an implementation strategy, a three-party consortium has been formed consisting of the seven vehicle manufacturers involved in the IVI, AASHTO and ten State departments of transportation and the USDOT.

Milestones: A decision to proceed with full deployment will be reached, accompanied by a plan for deployment.

APPENDIX-D ITS Standards and Protocols Information (Ref.4)

Identification of Available ITS Standards

Center to Center Related Standards

Data Dictionaries

- ITE-AASHTO TM1.03 Standard for Functional Level Traffic Management Data Dictionary (TMDD)
- Other ITS standards being used in the transportation community:
  - SAE J1746 – ISP-Vehicle Location Referencing Standard
  - SAE J2353 - Advanced Traveler Information Systems (ATIS) Data Dictionary

Message Sets (Please note that some ITS standards, including LRMS, are developed by IEEE and SAE, more details at their websites)

- ITE-AASHTO TM2.01 Message Sets for External Traffic Management Center Communications (MS/ETMCC)
- Other ITS standards being used in the transportation community:
  - IEEE 1512-2000 - Transportation Management Center (TMC) to Emergency Management System (EMS) Incident Management Message Sets
  - IEEE 1512.1-2003 - Traffic Incident Management Message Sets for Use by Emergency Management Centers
  - IEEE P1512.2 - Public Safety Incident Management Message Sets for Use by Emergency Management Centers
  - IEEE 1512.3-2002 - Hazardous Materials Incident Management Message Sets for Use by Emergency Management Centers
  - SAE J2313 - On-Board Land Vehicle Mayday Reporting Interface
  - SAE J2354 - Advanced Traveler Information Systems (ATIS) Message Sets
  - SAE J2369 - Standards for ATIS Message Sets Delivered Over High Speed FM Subcarriers
  - SAE J2374 - Location Referencing Message Specification (LRMS) Information Report

Protocols

- NTCIP 1104 - CORBA Naming Convention Specification
- NTCIP 1105 - CORBA Security Service Specification
- NTCIP 2304 - Application Profile for Data Exchange ASN.1
- NTCIP 2303 - Application Profile for File Transfer Protocol
- NTCIP 2202 - Internet (TCP/IP and UDP/IP) Transport Profile
- NTCIP 2104 - Ethernet Subnetwork Profile
- NTCIP White Paper – XML Protocols for Simple Object Access Protocol (SOAP) and Web Services Description Language (WSDL)
- Other ITS standards being used in the transportation community:
  - SAE J2374 - Location Referencing Message Specification (LRMS) Information Report

Center to Field Related Standards

Data Dictionaries

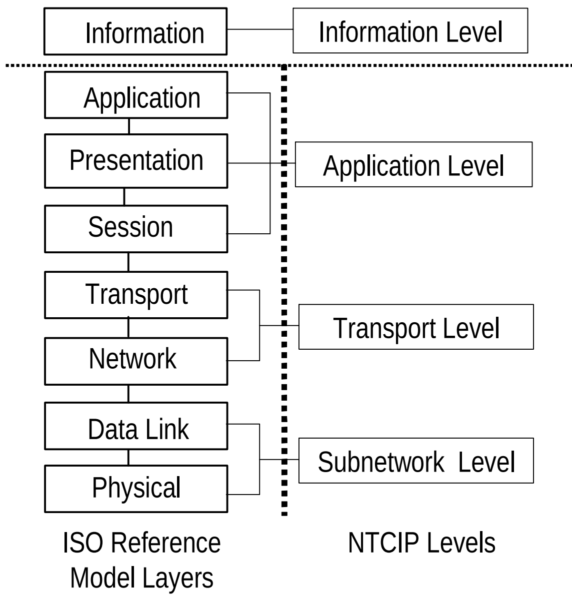
- NTCIP 1201 - Global Object (GO) Definitions
- NTCIP 1202 - Object Definitions for Actuated Traffic Signal Controller (ASC)
- NTCIP 1203 - NTCIP Object Definitions for Dynamic Message Signs (DMS)
- NTCIP 1204 - NTCIP Object Definitions for Environmental Sensor Stations (ESS)
- NTCIP 1205 - NTCIP Objects for Closed Circuit Television (CCTV) Camera Control
- NTCIP 1206 - Object Definitions for Data Collection and Monitoring (DCM) Devices
- NTCIP 1207 - Object Definitions for Ramp Meter Control (RMC) Units
- NTCIP 1208 - Object Definitions for Video Switching
- NTCIP 1209 - Data Element Definitions for Transportation Sensor Systems (TSS)
- NTCIP 1210 - Object Definitions for Signal System Masters

Protocols

- NTCIP 1101 - Simple Transportation Management Framework (STMF)
- NTCIP 1102 - Octet Encoding Rules (OER) Base Protocol
- NTCIP 1103 - Transportation Management Protocol (TMP)
- NTCIP 2301 - Simple Transportation Management Framework Application Profile
- NTCIP 2302 - Trivial File Transfer Protocol Application Profile
- NTCIP 2303 - Application Profile for File Transfer Protocol
- NTCIP 2201 - Transportation Transport Profile
- NTCIP 2202 - Internet (TCP/IP and UDP/IP) Transport Profile
- NTCIP 2101 - Point to Multi-Point Protocol Using RS-232 Subnetwork Profile
- NTCIP 2102 - Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile
- NTCIP 2103 - Point-to-Point Protocol over RS-232 Subnetwork Profile
- NTCIP 2104 - Ethernet Subnetwork Profile

ITS Standards Overview

Comparison of NTCIP Levels to the ISO Reference Model Layers



INFORMATION LEVEL STANDARDS

NTCIP 1201 - Global Object (GO) Definitions provides the vocabulary—commands, responses and information—necessary for general device management, including those objects required for device identification, time-based schedule configuration, and event log configuration.

NTCIP 1202 - Object Definitions for Actuated Traffic Signal Controller (ASC) provides the vocabulary—commands, responses and information—necessary for the management, control and monitoring of actuated traffic signal controller units

NTCIP 1203 - NTCIP Object Definitions for Dynamic Message Signs (DMS) provides the vocabulary—commands, responses, and information—necessary for traffic the management of dynamic message signs, which are used to advise and inform vehicle operators of current highway conditions.

NTCIP 1204 - NTCIP Object Definitions for Environmental Sensor Stations (ESS) provides the vocabulary—commands, responses and information—necessary for the management of environmental sensor stations, including Road Weather Information Systems (RWIS) and air quality monitoring systems.

NTCIP 1205 - NTCIP Objects for Closed Circuit Television (CCTV) Camera Control provides the vocabulary—commands, responses and information—necessary for the management of closed circuit television cameras, lenses, and pan/tilt units.

NTCIP 1206 - Object Definitions for Data Collection and Monitoring (DCM) Devices provides the vocabulary—commands, responses and information—necessary for the management of a data collection and monitoring unit which embraces a range of devices from traditional traffic counters to scale-houses for weigh stations.

NTCIP 1207 - Object Definitions for Ramp Meter Control (RMC) Units provides the vocabulary—commands, responses and information—necessary for the management of a ramp meter control unit consisting of a field controller, its suite of sensors, and associated warning signs and signals.

NTCIP 1208 - Object Definitions for Video Switching provides the vocabulary—commands, responses and information—necessary for the management of closed circuit television switching devices that control the association of video inputs to outputs, including the block switching of input and output groups, time-sequenced programming of multiple inputs, title/label generation by the video switch, and discrete input/output and switch status monitoring.

NTCIP 1209 - Data Element Definitions for Transportation Sensor Systems (TSS) provides the vocabulary—commands, responses and information—necessary for the management of **a** transportation sensor system which embraces a range of devices from smart inductive loop amplifiers to state-of-the-art technologies, such as machine vision and microwave.

NTCIP 1210 - Object Definitions for Signal System Masters provides the vocabulary—commands, responses and information— necessary for traffic management and operations personnel to control, manage, and monitor a traffic signal system master, which in turn manages a group of traffic signal controllers.

APPLICATION LEVEL STANDARDS

NTCIP 1101 - Simple Transportation Management Framework (STMF) specifies a set of rules and protocols for organizing, describing and exchanging transportation management information between transportation management applications and transportation equipment such that they interoperate with each other.

NTCIP 1102 - Octet Encoding Rules (OER) Base Protocol is a presentation layer standard that defines encoding rules for NTCIP objects i.e., the exact digital representation of the value of an object that is to be transmitted over various transfer services.

NTCIP 1103 - Transportation Management Protocol (TMP) is a composition of three distinct protocols all providing nearly identical services, but designed to meet different data exchange and processing requirements. The three component protocols are as follows: Simple Network Management Protocol (SNMP), Simple Fixed Message Protocol (SFMP), and Simple Transportation Management Protocol (STMP).

NTCIP 1104 - CORBA Naming Convention Specification defines the naming service for Common Object Request Broker Architecture (CORBA) for use in center-to-center communications within the transportation domain, as well as other environments that reference this standard, and lists the requirements for establishing names for management systems and for the objects managed by those systems.

NTCIP 1105 - CORBA Security Service Specification specifies the protocols and application interfaces needed to implement a CORBA based NTCIP center-to-center security interface, providing password protection to traffic data and device control at each center.

NTCIP 2301 - Simple Transportation Management Framework Application Profile specifies the requirements for information management and information transfers to and from devices in a networked environment by specifying the requirements for identifying, organizing, and describing the information to be transferred, specifying the methods for exchanging that information between an end-application and the communication protocol, and defining the procedures for encoding the information for transmission by a transport profile.

NTCIP 2302 - Trivial File Transfer Protocol Application Profile specifies the requirements for a simple, defined as those that do no provide authentication, block or file transfer mechanism to and from devices in a networked environment.

NTCIP 2303 - Application Profile for File Transfer Protocol specifies the requirements for reliable and full-featured file transfers in a networked environment by describing requirements for interactive access, formatting data, and authentication control.

NTCIP 2304 - Application Profile for Data Exchange ASN.1 specifies the requirements for communications between management systems in the United States using DATa EXchange - Abstract Syntax Notation (DATEX)-ASN.

TRANSPORT LEVEL STANDARDS

NTCIP 2201 - Transportation Transport Profile specifies the requirements for connectionless data communications transport services in a non-networked environment, consisting of an end system directly connected to a subnetwork and another compatible end system on the same subnetwork.

NTCIP 2202 - Internet (TCP/IP and UDP/IP) Transport Profile specifies the requirements for connectionless and connection-oriented data communications transport services over a connectionless network   Transmission Control Protocol (TCP) is used to specify the format of data and acknowledgements that two devices exchange to achieve a reliable transfer of information. User Datagram Protocol (UDP) specifies the format of data exchange needed to achieve such a transfer, but does not provide end-to-end acknowledgements of each piece (packet) of information. Both transport layers define a common mechanism for multiplexing information to and from multiple applications layers. Internet Protocol (IP) is used to specify the format of data and procedures to provide a connectionless, node-to-node information packet delivery service and routing.

SUBNETWORK LEVEL STANDARDS

NTCIP 2101 - Point to Multi-Point Protocol Using RS-232 Subnetwork Profile specifies the requirements for data transfers to and from devices in either a networked or direct-connect environment using an EIA/TIA-232 interface.

NTCIP 2102 - Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile specifies the requirements for unbalanced connectionless communications over an asynchronous, half-duplex or full-duplex dedicated twisted wire digital circuit using a 1200 bps Frequency-Shift Keying (FSK) modem interface.

NTCIP 2103 - Point-to-Point Protocol over RS-232 Subnetwork Profile specifies the requirements for data transfers to and from processors in direct-connect or circuit-switched environments using an EIA/TIA-232 interface and/or a dial-up modem.

NTCIP 2104 - Ethernet Subnetwork Profile specifies the requirements for data transfers to and from devices in either a networked or direct-connect environment based on the functions and operations defined in the "Ethernet" family of standards for peer-to-peer access over coaxial cable, twisted pair wire, or fiber-optic media operating at communication rates of 10 megabits per second.

NTCIP White Paper - XML Protocols for Simple Object Access Protocol (SOAP) and Web Services Description Language (WSDL) provides an approach for the implementation of XML-based communications in the exchange of information between ITS centers.

OTHER RELATED STANDARDS

Incident Management Standards

Coordination among the emergency management centers of agencies that respond to traffic-related incidents can be aided by a common set of established procedures and operational methods for exchanging vital data concisely, unambiguously, and rapidly. Typically, each involved agency has responsibilities that vary over time, based upon the type of incident, local custom, and agreed-upon responding resource allocations, which may be determined at the incident scene or at dispatching points within each agency.

IEEE has developed an incident management communications standard, IEEE Standard 1512 - 2000, for Common Incident Management Message Sets for Use by Emergency Management Centers. This standard is part of a family of related standards that address the communication needs of emergency and traffic management agencies that are involved in highway incident management and that need to exchange information with each other. It gives local agencies the ability to determine the level of cooperation and the messages that best meet their needs. In addition to the framework standard, subordinate standards have been developed to specifically provide incident management messages for traffic management, public safety and hazardous materials.

The incident management family of standards is intended to be used as the basis of mutual agreements among emergency management agencies to exchange information during incidents using messages comprised of agreed-upon data elements. The messages have been structured so that centers can continue to use different legacy systems. These standards also provide an overview of the relationships between the messages and examples of use with other ITS message sets.

IEEE 1512-2000 - Transportation Management Center (TMC) to Emergency Management System (EMS) Incident Management Message Sets addresses the messages communicated among different agencies' emergency management centers during and after the occurrence of an emergency incident. This document also provides a framework for more specific message sets.

IEEE 1512.1-2003 - Traffic Incident Management Message Sets for Use by Emergency Management Centers provides the messages communicated among different agencies' emergency management centers during and after the occurrence of an emergency incident. This document provides messages for traffic management message exchanges.

IEEE P1512.2 – Public Safety Incident Management Message Sets for Use by Emergency Management Centers provides the messages communicated among different agencies' emergency management centers during and after the occurrence of an emergency incident. This document provides messages for public safety message exchanges.

IEEE 1512.3-2002 – Hazardous Materials Incident Management Message Sets for Use by Emergency Management Centers provides the messages communicated among different agencies' emergency management centers during and after the occurrence of an emergency incident. This document provides messages for hazardous material message exchanges.

DATA DICTIONARY STANDARDS

ITE-AASHTO TM1.03 Standard for Functional Level Traffic Management Data Dictionary (TMDD) defines the data elements for information exchange between ITS centers that manage traffic.

ITE-AASHTO TM2.01 Message Sets for External Traffic Management Center Communications (MS/ETMCC) provides the messages to be used for information exchange between ITS centers that manage traffic.

SAE J1746 - ISP-Vehicle Location Referencing Standard describes format and vocabulary for location referencing between centers, such as transportation management centers, and vehicles.

SAE J2313 - On-Board Land Vehicle Mayday Reporting Interface specifies the messages that are exchanged between private service providers and local government emergency management agencies and their associated protocol interfaces.

SAE J2353 - Advanced Traveler Information Systems (ATIS) Data Dictionary specifies the data elements for advanced traveler information system (ATIS) messages. In addition, it may be used by other ITS systems that convey information about ATIS-related items.

SAE J2354 - Advanced Traveler Information Systems (ATIS) Message Sets specifies the messages that are exchanged among information providers, traffic management centers, and other ITS centers.

SAE J2369 - Standard for ATIS Message Sets Delivered Over Bandwidth Restricted Media specifies the message set for the transmission of advanced traveler information system (ATIS) messages over bandwidth-restricted media such as high speed FM Subcarriers and other wireless devices.

SAE J2374 - Location Referencing Message Specification (LRMS) Information Report describes a family if interfaces for each of the seven layers of the ISO reference model for use with the transmission of location references.

Appendix-E FHWA Final Rule and FTA Final Policy on ITS Architecture and Standards (Rule 940)

(Ref.1)

In 1997, Congress passed the Transportation Equity Act for the 21st Century (TEA-21) to address the need to begin working toward regionally integrated transportation systems. To implement Section 5206(e) of TEA-21, which requires ITS projects to conform to the National ITS Architecture (NITSA) and Standards, the Federal Highway Administration (FHWA) issued 23 Code of Federal Regulations Parts (CFR) 655 and 940, entitled “Intelligent Transportation Systems (ITS) Architecture and Standards” on April 1, 2001. Concurrently, the Federal Transit Administration (FTA) issued a Final Policy entitled “National ITS Architecture Policy on Transit Projects”. The intent of the FHWA Final Rule (commonly referred to as Rule 940) and Final FTA Policy is to provide policies and procedures by which to implement ITS projects in an efficient manner and to conform to the National ITS Architecture.

The purpose of the Final Rule/Final Policy is to accelerate the deployment of integrated Intelligent Transportation Systems (ITS) by requiring development of a regional ITS architecture. This regional ITS architecture, which is based on the National ITS Architecture but customized to meet a region’s particular needs, provides a plan by which a region can efficiently deploy ITS systems in a manner allowing for integration of these systems. The Final Rule/Final Policy defines 9 required components that make up a regional ITS architecture. These components are:

1. Description of the region
2. Identification of participating agencies and other stakeholders
3. Operational concept
4. Agreements required for implementation
5. System functional requirements
6. Interface requirements
7. Identification of ITS standards
8. Sequence of projects required for implementation
9. Process for maintaining your Regional ITS Architecture

Appendix-F

SAFETEA-LU AUTHORIZATIONS

Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)

Source: ***http://www.fhwa.dot.gov/safetealu/factsheets/factsheets-safetea-lu.doc***

SAFETEA-LU is the replacement legislation for next six years, and currently is under considerations by US Congress. The tables are provided for familiarization of the upcoming new law.

Detailed information fact sheet is available at:

http://www.fhwa.dot.gov/safetealu/factsheets/factsheets-safetea-lu.doc

Appendix-G

Federal Highway Administration

Operations

Current Program Activities

As of

August 2005

Federal Highway Administration

Operations

Current Program Activities Report

This report has been updated and summarizes recent activity of selected programs within the Office of Operations. The revisions reflect program titles that are consistent throughout the Office of Operations. For additional information about these or other activities, contact the program manager noted in each section. Additionally, more information may be available on the Office of Operations' web site: http://www.ops.fhwa.dot.gov. This report will be updated quarterly.

I. NON-RECURRING CONGESTION

A. Traffic Incident Management (TIM): Program Manager, Dave Helman (David.Helman@fhwa.dot.gov)

1. TIM Self-Assessment - The purpose of the Traffic Incident Management Self Assessment (TIM SA) is to provide a formal process for State and local transportation, public safety and private sector partners to collaboratively assess their traffic incident management programs and identify opportunities for improvement. At a national level the TIM SA helps the FHWA and its transportation and public safety partners identify national program initiatives to improve the practice of traffic incident management. National summary results are published each year, but individual urban results are not published. The National Summary report for the FY 2004 TIM SA was published in July 2005.

2. National Traffic Incident Management Coalition (NTIMC) - The coalition, facilitated through AASHTO, and made up of representatives of a number of transportation, public safety and private sector organizations, is now a year old. NTIMC members have adopted a Coalition mission and scope and formed task forces to outline Coalition organization and leadership, a Coalition Action Plan for the next 12 to 18 months, a Coalition Research Agenda, and a coordinated calendar of events of member associations that are related to traffic incident management or emergency transportation operations. The NTIMC has also developed a one-pager on traffic incident management "Key to Success" and a brochure on the NTIMC. The NTIMC has formed a Personal Protective Equipment Working Group and is working with ANSI on standards for reflectorized vests for public safety responders. The Coalition will also be involved in guiding the implementation of recommendations coming out of the

Traffic Incident Response Scan Tour (see no. 3 below). The next meeting of the NTIMC is scheduled for October 12, 2005 in Washington, DC.

3. Traffic Incident Response Scan Tour - In April 2005, a team of twelve representing transportation, law enforcement, fire and rescue, emergency medical services and trucking went on a scan tour of traffic incident response practices in England, Germany, Netherlands and Sweden. The team re-assembled in July and is developing both a final trip report and a Scan Technology Implementation Program (STIP) document, both to be completed in late 2005. The STIP will present several opportunities for putting what was learned in Europe into practice in the United States. The team members consisted of a number of organizations that are members of the NTIMC and the Coalition will be integrally involved in follow-up activities outlined in the STIP.

4. LAWTOW - TRAA National Drivers Certification Outreach - The Towing and Recovery Association of America (TRAA), with assistance from FHWA developed a three-level National Driver Certification Program (NDCP) in the mid 1990s. Nearly 10,000 tow operators have been certified by TRAA, but this represents only about 5% of the industry nationwide. FHWA, in cooperation with TRAA and the International Association of Chiefs of Police (IACP) is undertaking an effort to increase awareness of the value of certification and the numbers of certified drivers, particularly among those who respond to traffic incidents. This effort will involve the creation and distribution of an outreach package to the towing and recovery and law enforcement communities and the development of a TIMTOW Awareness and Operations Train-the-Trainer effort for the towing and recovery industry.

5. TIM Performance Measures - Eleven FHWA Division Offices have agreed to participate in an Operations Focus States initiative on Traffic Incident Management (TIM) Performance Measurement. The Texas Transportation Institute has been commissioned to develop a TIM Performance Measure White

Paper exploring the programmatic and technical issues in multi-agency program performance measurement. That White Paper will be completed in mid August. The purpose of the Focus States initiative is to identify appropriate measures of performance for TIM programs, identify who is now collecting and archiving data, and explore issues in fusing data from disparate public safety and transportation databases to form a more complete picture of traffic incident management activities. The initial outcome goal of this effort is for at least five of the states to begin using at least one of the TIM performance measures developed in this process, using currently available data. Achieving the short-term goal of the subject effort will establish a strong foundation for moving forward to develop more robust measures that all participants at an incident scene will consider germane. Representatives from transportation and law enforcement will participate in workshops to identify candidate performance measures. These workshops will be held in Washington, DC and Sacramento, CA the last two weeks in September.

6. **CAD FOT (Computer Aided Dispatch Field Operational Test)** - This FOT provides for the creation of teams in two states (Utah and Washington) to provide integration of data among transportation management and public safety CAD system databases to make rapid exchange of unambiguous incident-related information possible. This data integration will facilitate quicker and more appropriate response by secondary responders and provide better traffic and incident - related information to public safety agencies. The teams consist of a transportation agency and its systems integrator and a public safety agency and its CAD vendor. The Cooperative Agreements have been executed work is currently underway. The FOT is due to be completed by December 2005.

7. "**Managing Traffic Incidents and Roadway Emergencies",** National Highway Institute (NHI) Course No. 133048 - This workshop addresses many on-scene operations and communications issues as well as organizational issues. It

will continue to be presented to mid and upper level transportation, public safety and private sector partners. The course is available from NHI.

8. Model Procedures Guide - The Model Procedures Guide for Highway Incidents was prepared under the auspices of the National Fire Service Incident Management System. The Guide addresses on-scene incident command and control protocols (Incident Command) for traffic incidents and introduces an Incident Command System (ICS) position for Traffic Control. The Guide has been completed and is available on the FPP website at http://www.ifsta.org/ifsta/pdf/IMSHighway/IMS%20Highway.pdf for free downloading. Paper copies are also available for purchase from Fire Protection Publications (FPP).

9. NHI Course 133101 - Using the Incident Command System (ICS) at Highway Incidents - This new course is being developed by NHI and is targeted primarily to transportation responders. It will deal with ICS at highway incidents and describe what ICS is, its structure, and how it is used at highway incidents. The course will also contain two scenarios for class participants. ICS material presented will be based on the National Incident Management System (NIMS – Department of Homeland Security) and will also reference the Model Procedures Guide for Highway Incidents. Development of this course began in September. The technical walk through and pilot presentations of the course should occur in the fall of 2005.

10. Simplified Guide to Incident Command Systems for Transportation Professionals - The purpose of this Guide is to explain the Incident Command System (ICS) and its use at highway incidents under both Single Command and Unified Command structures. The materials will be based on the National Incident Management System (NIMS - Department of Homeland Security) and will also reference the Model Procedures Guide for Highway Incidents.

Development of this Guide began in October and should be completed in the late summer of 2005.

11. TIM Program Case Studies - The institutional structures of twelve various types of Traffic Incident Management programs were investigated and documented for this study. Six of those studied will be selected and documented in case studies. The final crosscutting case study will discuss how the programs were formed, what events or decisions lead to their formation, how they are sustained (institutionally, technically and financially), successes and failures (lessons learned), changes made since inception to support or strengthen the programs and recommendations on program structure needed to support multi-agency programs to effectively manage and resolve traffic incidents. The anticipated completion date for this study is late 2005. The case studies report will lay the foundation for a follow up effort to begin in FY 06 to develop a TIM Program Model that will outline successful approaches and structures for various types of regional or statewide TIM programs.

12. Non-Blinding Emergency Vehicle Warning Light Systems - This study, begun in October 2003, investigates the effect of various emergency warning light systems on driver comprehension and behavior and on the safety of on-scene emergency responders. This study is being conducted under a cooperative agreement with the United States Fire Administration (DHS/FEMA). A draft document is now being reviewed. The study is scheduled to be completed in late 2005.

13. Traffic Control Training for Emergency Responders - The FHWA is partnering with the United States Fire Administration (DHS/FEMA) through the International Fire Service Training Association (IFSTA) to develop effective technical guidance and training in traffic control at highway incidents in accordance with the Manual on Uniform Traffic Control Devices. Several documents on European practices obtained from the Traffic Incident Response

Scan Tour will also be incorporated into this guidance. The training will also clarify incident command procedures as described in the new Model Procedures Guide for Highway Incidents that was produced by the National Fire Service Incident Management System Consortium and requirements of the DHS National Incident Management System (NIMS).

14. Traffic Incident Management (TIM) Community of Practice (CoP) Website - As a component of the National Traffic Incident Management Coalition (NTIMC), this Community of Practice website will connect and serve practitioners in the key communities involved in traffic incident management, including but not limited to: the public safety community including fire, law enforcement and emergency medical services; federal, state and local departments of transportation; hazardous material; and towing/recovery; and private sector/non-profit transportation communities. The Traffic Incident Management Community of Practice website will link to current and planned websites in order to provide Community of Practice members with access to resources and references. One such planned website is the I-95 Corridor Coalition's Incident Management Clearinghouse. The website is currently under development.

B. Work Zone Management: Program Manager, Tracy Scriba (Tracy.Scriba@fhwa.dot.gov)

1. Work Zone Self-Assessment - To support the congestion mitigation vital few areas of FHWA, a comprehensive work zone self-assessment tool was developed and is distributed annually to all 52 FHWA Division Offices. The tool is intended to assist State DOT's in evaluating their existing work zone management practices and identifying areas for potential improvement. Each State completed the self-assessment in early 2003, 2004 and updated their scores in 2005. The report on the 2004 National results, including information on overall average scores and potential areas for improvement, is available at http://www.ops.fhwa.dot.gov/wz/decision_support/self-assess.htm. Individual state results are not available. The Self-Assessment process has resulted in increased awareness of, and communication on, work zone issues and has provided valuable insight as to what DOT's are doing to reduce the incidence of delay and crashes associated with work zones. The information is also being used to develop outreach, research, and deployment strategies within FHWA work zone program.

2. Work Zone Safety and Mobility Final Rule for 23 CFR 630, Subpart J - FHWA published the final rule in the Federal Register on September 9, 2004. The rule has a compliance date of October 12, 2007. FHWA is developing materials that will assist transportation professionals implement the rule. Materials under development include fact sheets, an Implementation guide, Communication and Outreach Strategies guide, a Transportation Management Planning guide, a Work Zone Impacts Assessment guide, and an advanced work zone training course (see #8 below). These support materials will be available in CY2005.

3. ITS and Work Zones Crosscutting Study - Using ITS in work zones can help ease traveler frustration, manage congestion, and prevent crashes. This study looks to educate maintenance and construction engineers and public sector managers about work zone ITS technologies and how they can be used to address work zone mobility and safety challenges. A study report, brochure, and four case studies present information on six work zone ITS applications used in states, including information on why the systems were selected, design and operational characteristics, issues/lessons learned, and the benefits derived from using the systems. The main study report also profiles other ITS-related work zone products, systems and techniques. The documents can be obtained at the work zone website at http://www.ops.fhwa.dot.gov/wz/its/index.htm. FHWA is currently finalizing an implementation guide that will provide information to practitioners on the considerations for selecting and implementing a work zone

ITS application. This implementation guide is expected to be ready for distribution in CY2005.

4. Full Closures for Work Zones Crosscutting Study - The purpose of this study is to raise awareness among construction engineers and managers of the applications and benefits of full road closure during rehabilitation and construction activities. Full road closures remove the worker-traffic interaction. This allows full access to the entire roadway section on which work will be performed and potentially improves efficiency and safety, and shortens the duration of work. Six field applications were researched, and project descriptions, rationale for using full closure, benefits, and lessons learned for each site was developed as part of the cross-cutting study. Information on the full road closure applications was gathered from site visits, interviews, and project related publications. A study report, brochure, and three new case studies describing the findings have been published and are available at http://www.ops.fhwa.dot.gov/wz/construction/full_rd_closures.htm.

5. Making Work Zones Work Better Workshop Series - This series of workshops was conducted to foster peer exchange and introduce the community of practitioners to new strategies and technologies for mitigating work zone impacts. In total, 20 workshops were held in 19 states and brought nearly 2500 transportation practitioners together to discuss strategic and tactical approaches to improving work zone mobility and safety. The series, a partnership activity among FHWA headquarters and field offices and State DOTs, highlighted the use of strategies such as ITS, full road closure, innovative contracting, and other promising work zone technologies and practices. Commentary from the workshops was captured to identify opportunities where FHWA could support broadly applicable improvements to work zone operations. With the initial series of workshops complete, support for future workshops in interested States has transferred to the Resource Center's Operations Technical Services Team. A guide to help states with hosting workshops is now available for use by the field offices.

6. Assessment of Work Zone ITS Effectiveness - FHWA is conducting a study to collect and evaluate data from six WZ ITS deployments to gather some quantifiable results of the effectiveness of ITS applications in work zones. Measures include elements of delay, queue length, and safety. Vehicle throughput and the delivery of information on work zones to travelers are also being considered. Data have been collected at three sites to date. Data collection will continue in the 2005 construction season.

7, QuickZone Traffic Impact Analysis Tool - Quick Zone is an Excel-based user-friendly software tool for estimating queues and delay in work zones. Through alternative analysis, the best staging/phasing plan and mitigation strategies can be identified to minimize user delay and queuing in work zones. Version 2.0 is now available through McTrans. This new version includes a graphical user interface for network development, an enhanced cost analysis tool, and two-way, one-lane operations modeling. Maryland SHA used QZ with great success on the Woodrow Wilson Bridge project. Eight case study documents on the use of Quick Zone will be published in CY2005.

8. Advanced Work Zone Management and Design Course - A new work zone course (#380072A) is being developed to add to the existing courses offered through the National Highway Institute (NHI). It will provide learners with broad skills and knowledge of technical and non-technical aspects of work zone traffic control practices. The course will include principles of planning, design, project management, and contract techniques. It is designed for those that have an understanding of principles of engineering judgment and studies, have management or design experience in work zone traffic control, and have an understanding of the Manual of Uniform Traffic Control Devices (MUTCD). The course is intended to be piloted in CY2005.

C. Road Weather Management: Program Manager, Paul Pisano (Paul.Pisano@fhwa.dot.gov)

1. **Principles and Tools for Road Weather Management, NHI course No. 137030A** (Lead, Roemer Alfelor, roemer.alfelor@fhwa.dot.gov) - A one-day course has been developed to introduce transportation decisions makers to the basics behind road weather information systems and the ways that they can be applied to address a host of weather-related problems. Topics include a review of road weather problems, meteorology for non-meteorologists, technology resources and implementations, and case studies. The course walk-through was conducted in June 2005, and the pilot has been scheduled for August 2005. The course is expected to be available by Winter 2005.
2. **Maintenance Decision Support System (MDSS)** (Lead, Paul Pisano, paul.pisano@fhwa.dot.gov) - The MDSS is a decision support tool for winter maintenance managers. It fuses relevant road weather forecasts, maintenance practices, and maintenance resource data into a "one-stop shop," providing recommended winter maintenance actions. Version 4.0 of the MDSS software will be available in Fall 2005 from the National Center for Atmospheric Research website www.rap.ucar.edu/projects/rdwx_mdss/. Eight states have now joined the pooled fund effort to develop an enhanced version based on the MDSS prototype, while others are in the process of procuring the software or have contracted with private vendors for MDSS-like capabilities. An MDSS Stakeholder meeting is also scheduled for October 2005 in Boulder, Colorado.
3. **Clarus (**Lead, Paul Pisano, paul.pisano@fhwa.dot.gov) - *Clarus* is an ITS initiative to develop and demonstrate an integrated surface transportation weather observing, forecasting and data management system, and to establish a partnership to deploy such a system nationwide. Clarus is intended to provide more timely, accurate and relevant road weather information that will be made available to all transportation managers and users so they can deal more effectively with adverse weather. The Clarus concept of operations was recently completed and work is underway to develop the system design and to demonstrate/test a prototype. The Initiative Coordinating

Committee has already met twice and will convene again in November 2005 to discuss the System Design. Additional information about the initiative can be found at: www.clarusinitiative.org.

4. **Road Weather Resource Identification (RWRI)** Tool (Lead, Roemer Alfelor, roemer.alfelor@fhwa.dot.gov) - The FHWA Road Weather Management Program has gathered hundreds of road weather resources including research reports, articles and other publications. The prototype RWRI tool, which contains a database of those resources, has been developed to help transportation professionals find the appropriate road weather documents to suit their specific needs. The tool enables the users to navigate the database resources using a guided search, a menu of topics search or a keyword search. The prototype tool will be available for download and testing from the FHWA web site in September 2005.

5. **FHWA-NOAA Partnering** (Lead, Paul Pisano, paul.pisano@fhwa.dot.gov) - On July 20, 2005, FHWA signed a multi-year memorandum of understanding with the National Oceanic and Atmospheric Administration (NOAA) to work together in conducting a variety of important research, development and deployment projects related to surface transportation weather. Some of the initiatives and products that are envisioned within the next year include a training CD on making the most of National Weather Service products, a research project to use National Weather Service Data to verify/check Road Weather Information System data, a proof-of-concept study for collecting road weather data from a vehicle, and general technical support for the Clarus initiative.

6. **Empirical Studies on Weather and Traffic** (Lead, Roemer Alfelor, roemer.alfelor@fhwa.dot.gov) - The Road Weather Management Program is currently undertaking a research project to utilize existing data and knowledge, and/or develop new models, to quantify the impacts of weather on traffic flow parameters including speed, volume and delay. The goal is to better understand the effects of adverse weather on traffic conditions to help identify appropriate traffic management strategies. A synthesis report was completed in March 2005 including a review of data sources. Work is underway to develop a data collection and analysis plan that will guide development of empirical models and relationships.

7. **Missouri DOT Weather Response System for Transportation Management**: (Lead, Roemer Alfelor, roemer.alfelor@fhwa.dot.gov) - The Federal Highway Administration (FHWA) is currently involved in a cooperative agreement project with the Missouri Department of Transportation (MoDOT) to develop and deploy a weather responsive system (WRS) for transportation management. The system will utilize weather data and products from various sources to support the application of traffic management, operations and highway maintenance strategies throughout the agency. The WRS prototype is currently being refined and will be tested and evaluated in the Kansas City district of MoDOT in Fall 2005.

8. **Integrating Weather Into TMC Operations** (Lead, Paul Pisano, paul.pisano@fhwa.dot.gov) - The Road Weather Management Team, in partnership with the Emergency Transportation Operations Team, sponsored a research project that began last year to conduct a survey and analysis of how weather and emergency information is currently being integrated into the operations of the Traffic Management Centers throughout the country. The goal is to identify best practices and use the information from the study to develop guidance. The research team conducted a preliminary/general interview of many TMC's around the country and selected 9 sites for detailed interviews. The team also held a workshop last June 2005 to discuss the results of the study. A draft final report is due at the end of August 2005.

D. Planned Special Events Traffic Management: Program Manager, Laurie Radow (Laurel.Radow@fhwa.dot.gov)

i. **National Conference and Proceedings** - Proceedings for the first National Conference on Planned Special Events, held December 1-3, 2004 was posted to the Planned Special Events website http://www.ops.fhwa.dot.gov/program_areas/sp-evnts-mgmt.htm in mid-May 2005. Hosted by FHWA, AASHTO, TRB, ITE, ITS America, APTA, APWA, the National Main Street Center and other key national interests, the purpose of the conference was to raise the awareness as to the importance and need to improve how public agencies plan, coordinate, manage travel, and control traffic for planned special events. This conference focused on lessons learned and how public agencies can improve the planning, coordination, and the management of travel for one specific event or for all planned special events with in a region.

ii. **Executive Summary of the "*Managing Travel for Planned Special Events*"** Handbook - The executive summary of the "Managing Travel for Planned Special Events Handbook" is designed to reach the decision makers and senior officials who need to be familiar with planned special events and who need to understand the importance of providing safe travel to and from these events; the value of regional coordination and collaboration to ensure the success of these events; and the merits of local, county and/or state agencies representing transportation, transit, public safety as well as private sector partners working together in the planning and implementation of these planned events.

iii. **NHI training course** - The pilot of the one-day overview and two-day workshop on managing travel for planned special events was held in June 2005. Delivery of the courses will begin in the fall of 2005.

iv. **Practical Checklists for Travel Management for Small, Medium, and Large Planned Special Events** - A series of checklists based on research of proven agency methods will include flowcharts that agencies can customize for their use in the permitting and planning for special events, as well as to identify when coordination with other agencies is necessary. The checklists will simplify tasks for small events, but provide increasingly responsible coordination, liabilities, and considerations for larger events. The project will involve the development of an evaluation plan to "categorize and size" the event, which will, in turn, identify necessary agencies, resources, lead-time, facilitation, and administrative approvals. The checklists will compile best practices of similar lists that have been created by individual agencies.

v. **Planned Special Events (PSE)/Traffic Incident Management (TIM) Workshop at TRB Annual Meeting** - With the theme of Commonality of PSE and TIM Planning and Actions, the morning portion of the January 22, 2006 PSE/TIM Workshop will focus on three cross cutting issues - TIM/PSE Tactical Planning; Comparison of TIM/PSE Post Action Activities; and Interchangeable use of PSE and TIM Plans. To emphasize these cross cutting issues, the speakers will focus on 1) how PSE and TIM actions are related and, 2) how actions of one could be used for the other. The morning session will include theoretical and practical materials. The afternoon session will include a tabletop or practical exercise.

vi. **2006 Joint Conference on Managing Travel for Planned Special Events and Traffic Incident Management -** Scheduled for late November/early December 2006, the 2006 National Conference will provide public agencies with information on how to best influence the practices related to planning for special events, and be better prepared to handle the aftermaths of a traffic incident.

Conference Information will be available on the conference website http://www.ops.fhwa.dot.gov/program_areas/sp-evnts-mgmt.htm

II. RECURRING CONGESTION

A. Arterial Management: Program Manager, Pam Crenshaw (Pam.Crenshaw@fhwa.dot.gov), http://www.ops.fhwa.dot.gov/arterial_mgmt/

i. **Traffic Signal Timing Manual** - An 18-month effort to develop a concise, practical, user friendly and modular guide to signal timing practitioners, focusing on the principals of traffic signal timing, identifying sound timing practices, and a practical and comprehensive tabletop resource. The target audience for this manual, expected to be completed in January 2007, will be state, city and local individuals responsible for the day-to-day timing and coordination of traffic signals, including planning, design, operations and maintenance staff who design, operate and maintain traffic signals, whether it be an individual signal, large signal system or somewhere in between.

ii. **Signal System Life Cycle Costing** - This investigation, scheduled for completion in July 2006, will focus on developing the techniques, and procedures needed to calculate total costs of signal cost items and develop a sound basis by which signal system options can be economically evaluated, consistent with practices learned from asset management. Providing guidance to support the accurate calculation of life cycle costs for signal systems is the first in a set of investigations geared at building an analytical foundation for operations asset management. After this investigation for signal systems, other investigations for other operations systems to develop life cycle costs will need to be undertaken.

iii. **Traffic Signal Training Assessment** - This assessment, available on the Arterial Management Web site in late Fall of 2005, will identify the knowledge, skills and abilities needed by various types of traffic signal practitioners in order to support good traffic signal operation, and will scan applicable training that is currently offered to identify gaps in existing training.

iv. **Case Studies For Regional Traffic Signal Timing** - The intent of this document is to show case studies of the successes and struggles of current or past programs to develop regional (i.e., across jurisdictional boundaries) traffic signal timing programs, that have been shown to reduce trip travel times by 8 to 25 percent. The case studies of regional traffic signal timing programs, available on the Web site in late Fall 2005, that can also be provided to agencies and transportation partners as a models, guides, or frameworks for establishing successful programs.

v. **Traffic Signal Timing On A Shoestring** - This effort, aimed at jurisdiction or municipalities that cannot afford to perform full-blown data collection and analysis studies, will explore and document the minimal amount of data collection and optimization that should be performed in a signal retiming project to acquire some appreciable benefits. Available on the Web site late Fall 2005.

vi. **Assessment of the State-of-the-Practice In Low Cost Traffic Engineering Improvements (Primer) -** An assessment of low cost strategies and programs used by local agencies to manage their arterials, this primer includes traffic signalization considerations, signal hardware and software, signing, markings, and geometric design and construction. Outreach efforts in conjunction with this document will be the issuance of supporting guidance documents to help jurisdictions keep their signals re-timed on a cyclical basis, and the minimal amount of data collection and optimization that should be performed in a signal retiming project to acquire some appreciable benefits. This document is available on the Web site as a complement to Traffic Signal Timing On A Shoestring.

vii. **Integrated Transportation Management for Small- and Medium-Sized Communities -** This workshop will help small communities consider all of the various ITS Systems and how to apply them to address their particular needs, encouraging the deployment of ITS in rural areas that are critical to the nationwide network. This course was piloted in May and is expected to be ready for scheduling in October 2005.

viii. **Small Communities Handbook** - Within this handbook, systems that apply various ITS components for ATMS and ATIS to appropriate categories of traffic and network characteristics are covered, as well as integrated and isolated traffic signals, small traffic signal systems, traffic management systems for seasonal and episodic events, and the communication systems that maybe applicable for incident, emergency and disaster management. A range of small communities of various sizes and populations are highlighted in order to capture the unique aspects of each. The Handbook is being distributed as part of the course materials for the ITS in Small Communities Workshop.

ix. **Traffic Control Systems Handbook -** The Traffic Control Systems Handbook is being revised to reflect the changes in technology and associated standards, the state of the practice, and recent FHWA requirements. This updated version will continue to help users understand the basic elements of traffic control systems and serve as a basic reference for the practicing traffic engineer, and is expected to be available on the Web site by late Fall 2005.

x. ***Access Management:*** Program Manager, Neil Spiller, (neil.spiller@fhwa.dot.gov), the website can be accessed at http://www.ops.fhwa.dot.gov/access_mgmt/index.htm.

Access Management Course Update #133078 - Beginning in summer, 2005, this course will undergo a one-year effort to update the current offering to incorporate NHI's Learning Objectives, to incorporate Power Point, to include metrification, and to make it 508 compliant. The pilot course is tentatively scheduled for June 2006.

Corridor Traffic Management: Program Manager, John Harding (John.Harding@fhwa.dot.gov)

Integrated Corridor Management (ICM) involves the coordination of transportation management techniques among networks in a corridor that together can collectively address congestion and improve overall corridor performance. Transportation corridors are usually characterized by a system of heavily traveled adjacent transportation networks that link major activity centers. Each of the networks provides an alternative means of mobility into, within, out of, or throughout the corridor. Each of the networks is usually operated in isolation except for pseudo coordination at facility junctions. This lack of coordinated operations among networks prevents effective use of the combination of these networks to address day-to-day congestion and congestion caused by work zones, incidents, weather, and special events. A coordinated effort among networks along a corridor can effectively manage the total capacity of a corridor and increase corridor trip performance by addressing corridor congestion.

Phase 1 activities have produced two stakeholder-developed definitions, one definition for "Corridor" and another for "Integrated Corridor Management". Activities over the summer have concentrated on developing the ICM concept. The development of the concept has included the development of a Generic ICM Concept of Operations and ICM Implementation Guidance. These phase 1 efforts were supported by stakeholder workgroup web conferences and a stakeholder conference held July 14 and 15 in

Philadelphia, Pennsylvania. Work continues on refining these and other Phase 1 research products and revising the rest of the ICM program plan, phases 2 through 4, to respond to stakeholders' needs and comments. Phase 2 is being refined to focus on the development of corridor development and analysis tools, corridor cross operations strategies, and corridor integration needs. Phase 3, the model deployment phase, which had consisted of a two-phased approach to select a model deployment site, is being rethought to respond to stakeholders' concerns about the transferability of one site. After the approval of the ITS Management Council, more information will be released concerning the content of phase 2 and the approach that will be taken in phase 3 to facilitate near-term deployments of Integrated Corridor Management Systems.

Freeway Management: Program Manager, Jessie Yung (Jessie.Yung@fhwa.dot.gov

Freeway traffic management involves the practice of combining personnel, operational strategies, advanced technologies, TMCs, and other techniques to proactively manage travel and control traffic on freeway facilities. It provides agencies with the ability to monitor roadway conditions, control traffic, identify recurring and non-recurring bottlenecks, detect and verify incidents, implement traffic management strategies, control traffic, and provide travel conditions information to motorists. The initiatives of the freeway management program focus on: 1) freeway operations and traffic management; 2) traffic management centers (TMCs); 3) managed lanes, and 4) HOV facilities.

Freeway Management & Traffic Operations

The Freeway Management & Operations Training Course (NHI Course #13375) course, available in October 2005, will provide participants with a general appreciation and understanding of the key policies, challenges and barriers, institutional issues, technical and other issues to consider in the planning, design, implementation, management, operation, evaluation, and marketing of freeway facilities. Details and scheduling for this course are available at http://www.nhi.fhwa.dot.gov/default.asp.

The Ramp Management and Control Handbook, available in October 2005, will provide guidance and recommended practices on managing and controlling traffic on freeway ramps through the enhanced use of and effectiveness of various ramp management and control strategies and techniques. The handbook presents the impacts that all aspects of roadway improvement planning have on the performance and management of traffic at freeway ramps.

Traffic Management Center (TMC)

The Configuration Management for Transportation Management Systems (NHI Course #137042) demonstrates the benefits and role of configuration management, and how it supports the development and operation of transportation management systems. Details and scheduling for this course are available at http://www.nhi.fhwa.dot.gov/default.asp.

The TMC Pooled Fund Study (PFS) is a forum of regional, State and local transportation agencies, and FHWA to identify issues that are common among public agencies, suggest, select, and initiate projects and initiatives to address these issues. Agencies are encouraged to join now, to participate with the 28 current members in the activities of the TMC PFS for 2005. The latest information on the following current projects, initiated or completed over the past five years, can be accessed at: http://tmcpfs.ops.fhwa.dot.gov.

1. The TMC PFS Quarterly Newsletter, *TMC Update*, provides featured articles, project status information, and latest news about TMC PFS members and activities.
2. The *TMC Operations Concept* project, scheduled for completion in Summer 2005, will develop a handbook, primer and brochure to provide guidance and recommended practices on the need for, how to develop, and use a concept of operations throughout a TMCs life cycle.
3. The *TMC Operator Requirements & Position Descriptions – Phase 2* project, scheduled for completion in Summer 2005, will revise the draft technical document produced in phase 1 and develop an enhanced software product to allow public agencies to develop operator requirements, tasks, knowledge, skills and abilities

(KSA's), and position descriptions based on the current or planned market packages or functions supported by their TMC.

4. The *TMC Business Planning and Plans* project, scheduled for completion in Summer 2005, will develop a technical document and primer providing guidance and recommended practices on the need for, how to develop, outlines various processes, identify types of business plans, supporting management systems, and use of business planning processes for TMCs. This project will also address various business planning models that have been successfully employed by transportation agencies to ensure the long-term sustainability of applications similar to TMCs.

   Information on projects to be initiated in 2005, including *Integration of TMC and Law Enforcement*, *Recovery and Redundancy of TMCs*, and *Procuring, Managing and Evaluating the Performance of Contracted TMC Services* can be accessed at: http://tmcpfs.ops.fhwa.dot.gov/cfprojects/new_search.cfm?new=3.

Managed Lanes

Managed lanes are freeway facilities where one or more operational strategies are proactively used to maintain free-flow conditions on a specific lane or set of lanes. Managed lanes address mobility, safety, and financial objectives and can significantly improve the performance of freeway facilities. However a number of issues critical to advancing managed lanes require greater understanding (e.g., legislative authority, demand forecasting, revenue use, design, management, traffic management and operation). The *Managed Lane Cross Cutting Study*, available electronically at http://ops.fhwa.dot.gov/freewaymgmt/managed_lanes/index.htm, summarizes the current practices, trends, lessons learned, gaps in practice, and research needs based on experiences from leading agencies from around the country. The *Managed Lanes Primer* will identify to senior managers the key challenges, opportunities and benefits, and will be available at the FHWA Freeway Management Program website in late Summer 2005.

The *Managed Lanes Traffic Control & Signing Study* summarizes the current practices, trends, lessons learned, gaps in practice, and research needs based on experiences from leading agencies from around the country will be completed in the Fall of 2005. The *Developing Managed Lanes* report will provide guidance to agencies addressing managed lanes issues at the earliest stage possible in the development process to maximize their potential for success. A draft of the report will be available for review in Fall 2005.

HOV Lanes: Program Manager, Neil Spiller (Neil.Spiller@fhwa.dot.gov)
The HOV Training Course (NHI Course #13375) will provide participants with a general appreciation and understanding of the key policies, institutional issues, challenges and barriers, technical, and other issues to consider in the planning, design, implementation, management, operation, evaluation, and marketing of HOV facilities. This updated course, available for presentation in 2006, is targeted at a wide range of individuals who may be responsible for or involved in activities that influence the HOV program, system, facility, or specific support services. Contact Greg Jones, GregM.Jones@fhwa.dot.gov, for more information.
The HOV Pooled Fund Study (PFS) provides a forum for regional, State and local agencies, transportation service providers, and FHWA to identify the key issues and challenges that are common among agencies, and propose, prioritize, and initiate projects and initiatives to address these challenges. The HOV PFS will focus on the critical program, policy, technical, and other issues that arise throughout the life cycle of an HOV facility. Agencies are encouraged to join the ten current member-agencies, to comment on projects selected and to propose new projects. Information about the current HOV PFS activities below can be accessed at http://hovpfs.ops.fhwa.dot.gov.

- The *HOV Lane Enforcement* project, scheduled for completion in Fall 2005, will develop a technical reference, primer, and brochure to provide guidance, recommended practices, and lessons learned on how to successfully enforce HOV lanes, integrate these needs in the design of HOV facilities and HOV program.

- The *Safety Considerations of HOV Facilities* project, scheduled for completion in Fall 2005, will develop a technical reference, primer, and brochure to provide guidance and best practices on the key issues, considerations, and potential impacts on safety related to various HOV facility issues, including roadway design features (e.g., facility type, shoulder widths, and types of ingress/egress), transit facilities, enforcement area and traffic incident management provisions, or signing or pavement marking.
- The *HOV Performance Monitoring, Evaluation, & Reporting* project, scheduled for completion in Fall 2005, will develop a technical reference, primer, & brochure providing guidance and best practices with monitoring, evaluating, and reporting on HOV system performance to foster improvements in the planning, design, management and operation of HOV facilities and support services.
- The *HOV Hours of Operation and Eligibility Requirements* project, scheduled for completion in Fall 2005, will develop a technical reference, primer, and brochure to provide guidance and best practices on how to evaluate the benefits and potential impacts with making potential modifications in the hours of operation and or vehicles that are allowed to use different HOV facilities, addressing specific trade-offs with setting and changing eligibility requirements and operating periods along with the supporting methodologies, process, tools, and techniques to support the analysis of these issues.
- The *Website Clearinghouse and Facility Database* project will create an interactive database of Arterial and Freeway HOV facilities with up to date information on selective parameters including length, age of facility, # of lanes, measures of effectiveness, hours of operation, vehicle eligibility, and where available, history of the facility.

Travel Demand Management (TDM): Program Manager, Wayne Berman (Wayne.Berman@fhwa.dot.gov)

1. TDM Reference Guide – Update - The objective of this project is to update the 1993 Reference Guide based upon a new "operations –oriented" model for TDM in

a contemporary environment. The updated Reference Guide entitled "Mitigating Traffic Congestion – The Role of Demand-Side Strategies" contains two principal sections – one to address TDM for commute trips and one to address TDM for non-commute trips. Each section is developed based on five to ten case examples that illustrate contemporary enablers of TDM, such as information, technology, and financial incentives. The Reference Guide is available electronically on the Office of Operations website: www.ops.fhwa.dot.gov. Hard copies are also available by contacting Wayne Berman at Wayne.Berman@fhwa.dot.gov.

2. Managing Demand Through Traveler Information Services - The objectives of this project are: 1.) To compile existing information on how, where, and under what circumstances traveler information services are affecting or managing demand and 2.) To package the information compiled into a colorful, easy-to-read, 25-page brochure. The brochure highlights the opportunities and benefits for using traveler information services to manage demand during periods of recurring and non-recurring congestion, including special events and emergencies. The brochure is available electronically on the Office of Operations website: www.ops.fhwa.dot.gov. Hard copies are available in Spring 2005 by contacting Wayne Berman at Wayne.Berman@fhwa.dot.gov.

DAY-TO-DAY OPERATIONS

Manual on Uniform Traffic Control Devices: Program Manager, Hari Kalla (Hari.Kalla@fhwa.dot.gov)

i. Pavement Marking Quiz and Tutorial - is a new educational feature added to the MUTCD website in July 2005. This is an excellent tool for learning about pavement marking types, colors, patterns, widths, symbols, and words.

ii. Traffic Control Devices Pooled Fund Study - The experimentation process for updating the MUTCD is time-consuming and involves evaluation reports. The experimental process has been used by jurisdictions as a mechanism for on-road testing and evaluation of innovative traffic control devices. FHWA has established a pooled fund study for traffic control devices that is intended to provide a quicker way to assess low risk new traffic control devices and applications. The panel has selected 2 projects this year, which are:

- Evaluation of 11 new symbols (expected completion is Fall of 2006)
- Stutter flash for overhead beacons (expected completion is Winter of 2006)

Accommodating Persons With Disabilities - The FHWA has been working with the US Access Board to identify potential research topics/areas on traffic control device that could better accommodate the needs of pedestrians with disabilities. The research areas identified include MUTCD pedestrian signage and pavement markings (color, contrast, reflectivity, legibility, mounting specifications, viewing distance, meaning) to determine effectiveness for persons with low and impaired vision, older persons, and children. The first MUTCD/ADA research project has been initiated. The project title is “Visual Detection of Various Detectable Warning Materials for Pedestrians with Visual Impairments”. The overall objective of the project is to assess the relative visual detection of color, contrast, reflectance, and other factors in a range of detectable warning materials. The project is scheduled for completion by the end of CY 2005. Findings and recommendations of the study will help determine color and contrast standard for detectable warning to be included in the MUTCD.

Developing Traffic Control Strategies at Toll Booth Plazas - The FHWA has underway a contract to review current practices and develop best practices for traffic control at toll plazas. The purpose of the best practice report is to have a consistent strategy for guiding and controlling the movement of vehicles through the toll facility in an orderly manner so that safety and operations are enhanced, better efficiency and economy of design are achieved, potential points of conflict are minimized, and motorist recognition and comprehension are improved. The goal of this effort is to create consensus among the various toll facilities. The draft report was forwarded to the toll facilities, ITE, the National Committee, and other interested parties for review and comment. The comment period ends August 26, 2005 and the months of September and October will be dedicated to analyzing comments and revising the report. The best practices report is planned for publication and distribution at the January 2006 TRB meeting.

Operations Asset Management: Program Manager, John Harding (John.Harding@fhwa.dot.gov), http://www.ops.fhwa.dot.gov/program_areas/ops-asset-mgmt.htm

i. Operations Asset Management Program Plan and Road Map - The initial Operations Asset Management Program is structured to establish and promote the implementation of Operations Asset Management practices that will lead to the inclusion of operations asset resource allocation needs in a coordinated Transportation Asset Management (TAM) process. For operations professionals to be successful in establishing Operations Asset Management, they need analytical tools, procedures, processes, policies, and an overall system methodology of how Operations Asset Management relates to and is integral to TAM and system performance. To provide operations professionals with the resources they need to implement Operations Asset Management, the program has been divided into 3 interconnected research areas which are 1) Establishment of An Analytical Foundation, 2) Creation of Operations Asset Management and Linkages to TAM, and 3) Institutionalization of Operations Asset Management.

An initial investigation to identify the elements of signal system asset management resulted in two reports: The State-of-the-Practice report for Signal System Asset Management, and The Elements of a Comprehensive Signal System Asset Management System, both available on the Operations Asset Management Web site.

Current efforts are underway to identify operations assets and signal system life-cycle- costs. The first investigation, available in late Fall 2005, is the Identification of Operations Assets to establish a base line from which analytical capabilities; and data, information, and performance measure needs can be identified. The second investigation will develop life cycle costs for signal systems as described in the *Arterial Management Program* under the RECURRING CONGESTION section above.

Real Time Traveler Information: Program Manager, Bob Rupert (Robert.Rupert@fhwa.dot.gov), http://www.ops.fhwa.dot.gov/travelinfo/

i. The ATIS / 511 Guidance, Lessons Learned and Technical Assistance activity provides a means to share information with others that may be planning to develop traveler information systems. The evaluation for the 511 Model Deployment (http://www.ops.fhwa.dot.gov/511/current_activities/511model.htm) has been completed and its final report will be published in September 2005. The FHWA 511 Web site, http://www.ops.fhwa.dot.gov/511, provides status and links to the 26 systems in operation in 23 States as of July 2005. The 511 Deployment

Coalition, FHWA and FTA are cooperating to provide outreach and assistance to metropolitan areas identified for focused attention to encourage and assist the implementation of 511 services in their regions, to help reach the goal of 50% of the country's population having access to 511 by the end of 2006. *Resource 511* (www.deploy511.org), the Web site for the 511 Deployment Coalition, is the main repository of information from the 511 Coalition including version 3.0 of Guidelines, "Quick Tips" report on interoperability, the 2005 Annual Progress Report, marketing information and contacts for all the 511 systems.

ii. The AMBER Alert Guidance, Support and Implementation Program includes the AMBER Alert Plan Assistance Program and the AMBER Plan Implementation Assistance Program. The Plan Assistance Program provided up to $125,000 to States to help them determine how transportation agency resources can best be used when child abduction alerts are issued by law enforcement agencies, and as of July 2005, a total of $5,134,520 in grants had been provided covering 42 States and the District of Columbia. The Implementation Assistance Program provides up to $400,000 to States for implementing motorist information systems to notify motorists when child abduction alerts are issued, and as of July 2005, a total of $13,148,000 in grants had been provided to 32 States and the District of Columbia.

iii. Travel Times on Dynamic Message Signs activities encourage and assist states and metropolitan areas in posting travel time messages on dynamic message signs (DMS). Many DMS across the country are often blank or show messages that have little use to drivers, but cities that currently post travel time messages enjoy wide public support for their efforts. A workshop was held in Atlanta in March 2005 where participants learned from locations that provide travel time messages (Atlanta, Milwaukee and San Antonio) on how to post travel time messages and overcome common hurdles such as data quality/quantity, public outreach and response, and software issues. Proceedings and presentations from this workshop are available on the ITS America website at http://www.itsa.org/dms.html. Case studies have been developed and are being printed on four cities that post travel time messages: Chicago, Houston, Nashville and Portland, Oregon. The case studies will be useful to other cities in that they will document the obstacles overcome in order to post the messages. The Resource Center or headquarters are available to conduct workshops based on the information from the Atlanta workshop and the case studies for local or regional stakeholders. For more information, please contact Brandy Meehan at Brandy.Meehan@fhwa.dot.gov.

iv. **Intelligent Transportation Infrastructure Program (ITIP):** Program Manager, Chung Eng (Chung.Eng@fhwa.dot.gov)

This ongoing program is designed to enhance regional surveillance and traffic management capabilities in up to 21 metropolitan areas while developing an ability to measure operating performance and expanding traveler information through public/private partnerships. To date, deployment has been completed in the initial cities of Pittsburgh and Philadelphia, and in the expansion cities of Chicago, Providence, Tampa, and Boston. Construction is currently 70% complete in San Diego, 50% complete in the Washington, DC region, 50% complete in St. Louis, and 45% complete in Los Angeles. System design has been completed in Detroit, Oklahoma City, Phoenix, and San Francisco, and is under way in Seattle. Additionally, a local agreement has been executed for Baltimore, and full authority to proceed with system development in Baltimore will be granted upon approval of an implementation strategy. Negotiations are also currently active in 5 additional cities.

v. iFlorida Model Deployment - The iFlorida model deployment will demonstrate and evaluate how the safety, security and reliability of the surface transportation system can be enhanced through the widespread availability of real-time information. The project was awarded May 1, 2003, deployment of the iFlorida field hardware was completed in April 2005, and systems acceptance testing was completed during the summer of 2005. The operational phase of iFlorida will begin on September 1, 2005 with a kick off and press event in Orlando. The project evaluation is underway and the Evaluation Design Review has been completed. Project documents, as well as other project information, can be found on the iFlorida website at www.iflorida.net. The iFlorida documents and key evaluation documents are also posted on the ITS Electronic Document Library (EDL). For more information on the iFlorida model deployment, contact Toni Wilbur at Toni.Wilbur@fhwa.dot.gov.

Traffic Analysis Tools: Program Manager, John Halkias (John.Halkias@fhwa.dot.gov), http://www.ops.fhwa.dot.gov/trafficanalysistools/

i. Next Generation Simulation (NGSIM) Core Algorithms and Data Sets - This effort is to develop a core of open behavioral algorithms in support of traffic simulation with supporting documentation and validation data sets that describe the interactions of multi-modal travelers, vehicles and highway systems. These products will be openly distributed and made freely available to the broad transportation community. For more information, please visit the NGSIM web site at http://ngsim.fhwa.dot.gov.

ii. TAT Workshops - A third workshop (including the pilot) to disseminate the TAT products (Primer, et al) and present hands-on methodologies to make best choices when using microsimulation tools, is scheduled for 25-27 participants and 7-8 instructors in Portland, OR, on September 13-15, 2005.

iii. Traffic Analysis Tool Primer - is an overview of traffic analysis tools, available through the web site at http://ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm.

iv. Decision Support Methodology for Selecting Traffic Analysis Tools - This is an on-going project to assist traffic engineers and traffic operations professionals in the selection of the correct type of traffic analysis tool for operational improvements. In addition, this document will assist in creating analytical consistency and uniformity across State Departments of Transportation and Federal/regional/local transportation agencies. The report is available through the web site at http://ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm.

The Guidelines for Applying Traffic Micro-simulation Modeling Software are designed to provide practitioners with guidance on the appropriate application of micro-simulation models to the estimation of traffic performance for freeways, highways, rural roads, and city streets. These guidelines aid practitioners in the development, calibration, and application of micro-simulation models, and are available through the web site at http://ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm.

The CORSIM Application Guidelines describe the proper use of the CORSIM tool in analyzing real-world transportation problems, building upon the generic FHWA simulation guidelines as a framework and adding CORSIM-specific guidance. In addition, these guidelines will aid the CORSIM user in applying the software to more "advanced" problem applications. The report will be available in December 2005 through the web site at http://ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm.

Traffic Analysis Tools Case Studies: Benefits and Applications will serve to document real-world applications of the various available tools, and will address topics such as the rationale for selecting the particular analysis procedure(s) employed, the manner in which each tool was applied, the specific benefits achieved, and possibly even the significant pitfalls that were encountered. The report will be available September 2005 through the web site at http://ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm.

DYNASMART-P represents a new generation of tools to support transportation network planning and operations decisions in the ITS and non-ITS environments. It combines dynamic network assignment models with traffic simulation models. DYNASMART-P has been packaged with DSPED (the Network Editor) and is being released to the public through McTrans Center.

FHWA R&D initiated a Dynamic Traffic Assignment (DTA) research project to develop advanced network-wide traffic models to address complex traffic control and management issues in the information-based, dynamic ITS environment. Under this project, two prototypes of Traffic Estimation and Prediction System (TrEPS) for real time traffic management and two prototypes for offline Operations Planning (TrEPS-P) were developed. All prototypes can be used for corridor traffic management analyses, both online and offline analyses. The two TrEPS prototypes are being field-tested.

CREATING A FOUNDATION FOR 21ST CENTURY OPERATIONS

Planning for Operations: Program Manager: Wayne Berman (Wayne.Berman@fhwa.dot.gov)

1. Demonstration projects on "Regional Transportation Operations Collaboration and Coordination" - Funding is planned in FY 2005 and FY 2006 for demonstration projects in three cities to serve as laboratories to develop and showcase Regional Transportation Operations Collaboration and Coordination. The three demonstration sites are Detroit, MI; Tucson, AZ; and Portland, OR. For more information on this initiative, please contact Chung Eng (Chung.Eng@fhwa.dot.gov) or Wayne Berman (Wayne.Berman@fhwa.dot.gov).

2. Advancing Transportation Systems Management and Operations Training Course and Executive Session - This course and Executive Session are intended to provide instruction on concepts, principles, and experiences needed to advance a regional perspective for Transportation Systems Management and Operations. The three key aspects address in both the course and executive session are greater operations collaboration and coordination, emphasizing operations in the planning process, and better linking planning and operations. Both the course and executive session are available and are intended for planners and for professionals with day-to-day experience in management and operations in both transportation and public safety communities. For more information on this initiative, please contact Wayne Berman (Wayne.Berman@fhwa.dot.gov).

3. Regional Concept for Transportation Operations - A white paper has been prepared to begin to frame a Regional Concept for Transportation Operations as a management tool for guiding regional transportation operations collaboration and coordination. The white paper is available electronically on the Office of Operations website: www.ops.fhwa.dot.gov. Hard copies are available by contacting Wayne Berman at Wayne.Berman@fhwa.dot.gov. Further guidance is planned in late 2005 to articulate the benefit and importance of it, and identify the steps necessary to make it an accepted and valued action for transportation operators and public safety managers in metropolitan areas.

4. Opportunities for Linking Planning and Operations - The FHWA Office of Operations and the Office of Planning, Environment, and Realty have jointly prepared a new reference manual. The reference manual identifies and helps develop nine opportunities for planners and operations staffs to work closer together and thereby facilitate better linkages between planning and operations. Some of these opportunities include development of operations performance measures, data sharing, the regional ITS architecture, and the congestion management system. The reference manual is available electronically through the Office of Operation's website at www.ops.fhwa.dot.gov. Hardcopies are available by contacting Wayne Berman (Wayne.Berman@fhwa.dot.gov) or Harlan Miller (Harlan.Miller@fhwa.dot.gov).

5. Plan4Operations Website - A new website, developed joint between the FHWA Office of Operations and the Office of Planning, Environment, and Realty, is available to serve as a resource for information related to planning for operations. The address is www.plan4operations.dot.gov/.

B. Performance Measurement: Program Manager, Rich Taylor (Rich.Taylor@fhwa.dot.gov), http://www.ops.fhwa.dot.gov/perf_measurement/

i. Mobility Monitoring Program (MMP) - FHWA is working closely with TTI to develop and calculate area wide, travel-time based performance measures using archived data from freeway management systems. This program has grown to include 28 cities in 2004. The program tracks three congestion measures (travel time index, percent congested travel, and delay) and two reliability measures (buffer index and planning time index). Up to 33 cities will be included in 2005 as circumstances permit. For more details, visit the mobility monitoring program web site at http://mobility.tamu.edu/mmp.

ii. Monthly Urban Congestion Reporting - This on-going program acquires travel time data from web sites in 10 metropolitan areas and uses it to calculate key travel time reliability performance measures on a monthly basis. Beginning in Fall 2005, the same monthly performance measures will be developed using MMP data from up to 20 cities.

iii. Developing reliability measure outreach materials - This on-going program develops materials for an outreach campaign to advance the state of the practice in travel time reliability performance measurement and to broaden acceptance of its use by public agencies. A guidance document is currently being created (due December 2005). Another good source of information on the reliability and other operations performance measures is the National Transportation Operations Coalition (NTOC) Performance Measures report: http://www.ntoctalks.com/ntoc/ntoc_final_report.pdf.

iv. FHWA National State of Congestion Report - FHWA published and distributed the first annual FHWA National State of Congestion Report in FY2004. The report was released in conjunction with the Texas Transportation Institute's Urban Mobility Study that focuses on congestion at the state and metropolitan levels. The 2005 report will be available beginning in early September 2005. The report may be viewed at http://www.ops.fhwa.dot.gov/congestion_report/index.htm.

v. Sources of Congestion Study - The goal of this study is to help build a more thorough understanding of the causes of congestion and to identify targeted strategies to mitigate those sources of congestion. The study results will be available in Fall 2005.

vi. Freight Performance Measures: Program Manager, Crystal Jones (Crystal.Jones@fhwa.dot.gov) - HOFM is developing performance measures for travel time in freight-significant corridors and at border crossings. Private sector data collected from tracking and communications technologies are used to measure travel time variability and border crossing delays. These travel-time measures will provide useful insights on intercity highway network performance. Initial proof-of-concept tests have been completed. In the upcoming months, FHWA will be leading and/or participating in several meetings to solicit input on the initiative from various stakeholder groups. By the end of December 2005, FHWA will have baseline measurements of travel rates, travel time, and travel time reliability (a buffer index and travel time index) for an initial five Interstate highways identified as freight significant.

C. Facilitating Integrated ITS Deployment: Program Manager, Steve Clinger (Stephen.Clinger@fhwa.dot.gov)

i. Regional ITS Architecture Implementation: Program Manager, Emiliano Lopez (Emiliano.Lopez@fhwa.dot.gov)

On April 8, 2005 the FHWA "Final Rule on Architecture and Standards Conformity" went into effect. The Final Rule/Policy requires States and metropolitan areas to have a regional ITS architectures in place and follow a systems engineering process for ITS project development if there is intent to spend Federal-aid dollars on ITS deployment. Training, technical guidance and best practices are currently available on the architecture conformity website (http://www.ops.fhwa.dot.gov/its_arch_imp/index.htm).

a) ITS Architecture Training and Technical Assistance Program - FHWA continues to sponsor a variety of training and technical assistance activities designed to assist States and metropolitan areas to develop, use and maintain regional ITS architectures. The program is now focusing on use and maintenance of regional ITS architectures. A one-day facilitated session entitled "Using Your Regional ITS Architecture" describing which elements of the regional ITS architecture apply to a region's transportation planning process and ITS project development process, is now available through the FHWA Division offices. In FY 2006, a "use and maintenance" workshop/seminars will be developed and made available.

b) Regional ITS Architecture Guidance - The "Regional ITS Architecture Guidance Document" will be updated, with delivery anticipated in FY 2006. The "Regional ITS Architecture Maintenance White Paper" (EDL # 13957) is now available and provides guidance on what should be contained in a regional ITS architecture maintenance plan and on the configuration management and process of maintaining a regional ITS architecture. The recently published "Regional ITS Architecture Maintenance Technical Advisory" provides further information on resources needed to effectively maintain a regional ITS architecture including: estimated resources needed, variables that influence resource allocation, and situations where substantially more resources may be needed.

ITS Standards Deployment: Program Manager, Tom Stout (Tom.Stout@fhwa.dot.gov)

The Intelligent Transportation Systems (ITS) Standards Program has evolved from its initial focus on standards development to one that emphasizes standards implementation, encouraging the widespread use of standards to promote interoperability and interchangeability of ITS devices and systems by providing deployment support. Deployment support includes helping to build confidence in the standards through testing and case studies, by providing standards resource information, by developing and delivering standards training courses, by providing training and technical assistance to deployers, by collecting and disseminating deployment experience-based guidance such as "lessons learned", and by assessing the readiness of standards for deployment.

a) Overview and Introductory Courses delivered in a classroom format provide a basic understanding of the ITS communications standards, including how the standards are defined by the ITS Natural Architecture, their purpose, and how they are combined to achieve an agency's traffic management objectives. The following introductory courses are available.

- A one-day ITS Standards Overview is intended for transportation professionals and policy makers that are, or may be involved in ITS deployment;

- A one-day Center-to-Center Communications (C2C) introduction to the information level communications standards, including the Traffic Management Data Dictionary (TMDD), Advanced Traveler Information System (ATIS) standards, IEEE 1512 Incident Management Standards, and XML Schema; and the information level communications standards. This course and the next one are intended for designers and deployers of ITS traffic control and management systems;
- A one-day introduction to the use of NTCIP 1203 standard for Dynamic Message Signs and the supporting applications, transport, and sub network level NTCIP standards.

b) Advanced Training - Classroom training to discuss in detail the particulars of what is necessary to develop successful procurement documents incorporating NTCIP standards. The course is designed for professionals responsible for specifying/procuring ITS systems.

- A two-day DMS Procurement Workshop to develop procurement documents incorporating NTCIP 1203 Version 2.x dynamic message signs may be customized to include additional topics, such as testing, that may be of interest to agencies that will attend the workshop.
- The Incident Management Workshop provides deployment guidance for the incident management and traffic incident related message sets addressed by the IEEE 1512® Family of standards.

c) Technical Assistance Program - The Federal Highway Administration has established a technical assistance program to provide short-term, on-call assistance to solve ITS standards implementation issues.

- The FHWA's Peer-to-Peer Program scope has been expanded to provide the assistance of specialists in all areas of ITS standards to assist public agencies implement standards based systems. For the most part these specialists are from the public sector and are knowledgeable of the range of problems and benefits that may be encountered when deploying ITS standards.

- The Field Support Team (FST) is comprised of FHWA specialists who are prepared to provide short-term, on-call ITS standards assistance in supporting and facilitating deployment of ITS standards.

d) Guidance - The FHWA ITS program has developed numerous documents to guide agencies in deploying ITS standards, available from http://www.ops.fhwa.dot.gov/int_its_deployment/standards_imp/standards.htm.

3. Systems Engineering: Program Manager, Emiliano Lopez (Emiliano.Lopez@fhwa.dot.gov)

The clear requirement within the Final Rule/Final Policy is that all ITS projects must be developed using a systems engineering process, which includes: concept of operations, functional requirements, identification of agencies and roles, identification of applicable standards, alternative analysis, procurement options, and system operations and management.

a) Systems Engineering Training Series includes:

- Introduction to Systems Engineering
- Applied Systems Engineering for Adv. Transportation Projects
- Managing High Technology Projects in Transportation
- ITS Procurement/ITS Software Acquisition
- Configuration Management for Traffic Management Systems
- Regional Planning for Operations
- Recommended Practices for Operations of Advanced Transportation Systems

b) The following ITS Systems Engineering Guidance documents are available through the EDL and on the Architecture Conformity area of the ITS website (www.its.dot.gov).

- "Building Quality Intelligent Transportation Systems Through Systems Engineering" (EDL # 13620) introduces the topic of systems engineering to managers and staff working on transportation systems projects, with particular emphasis on Intelligent Transportation Systems (ITS) projects.
- "Developing Functional Requirements for ITS Projects" (EDL #13621) discusses the value and importance of good functional requirements, particularly focused on ITS projects, as part of an overall systems engineering development process.
- "A Guide to Configuration Management for Intelligent Transportation Systems" (EDL #13622) discusses the configuration management process as a way to manage change and maintain consistency of performance and design of ITS projects.

IMPROVING GLOBAL CONNECTIVITY BY ENHANCING FREIGHT MANAGEMENT AND OPERATIONS

Freight Analysis

i. Freight Analysis Framework: Program Manager, Tianjia Tang (Tianjia.Tang@fhwa.dot.gov)

FHWA's Office of Freight Management and Operations (HOFM) plans future enhancements to the Freight Analysis Framework (FAF), including new benchmarks to the 2002 Economic Census, provisional estimates of current freight flows, quality checks and enhancements, and links to policy models such as the Highway Economic Requirements System (HERS). The 2002 benchmark FAF origin-destination database will be released in January 2006, and forecasts and the FAF network database will be released by summer 2006. These products are described in the FAF plan posted on the HOFM Web site.

Benefit/Cost of Freight: Program Manager, Rob Mulholland (Robert.Mulholland@fhwa.dot.gov)

HOFM completed initial research (Phases I & II) on improved methods for estimating the long-run economic benefits to shippers and carriers arising from freight transportation investments. Traditional benefit-cost analysis methods base the value of transportation investments on short-term cost savings to highway users without properly accounting for the effect of changes in shipper/carrier behavior and industry reorganization in response to improved transportation system performance. Initial research suggests the benefits may be understated by 15 percent using traditional as the models that do not capture long-term productivity gains. Phase III research will focus on creating a planning tool that captures the full benefits associated with freight transportation (infrastructure and operational) improvements.

Freight Model Improvement Program: Program Manager, Tianjia Tang (Tianjia.Tang@fhwa.dot.gov)

In cooperation with the Office of Environment and Planning, HOFM is developing a Freight Model Improvement Program (FMIP). FMIP is intended to assess the state of the art and state of practice in freight forecasting and evaluation models, identify needs for short-term improvements and long-term research, and provide a forum in which the transportation community can improve both the state of the art and state of practice. The FMIP Web site is operational at www.fmip.gov. HOFM is also working with its DOT partners and the

Transportation Research Board to organize a national conference in conjunction with TRB's Summer 2006 meeting.

Freight Professional Development (FPD): Program Manager, Carol Keenan, (Carol.Keenan@fhwa.dot.gov)

In partnership with the Office of Planning and the Resource Center Planning Team, HOFM continues to develop courses in response to customer needs. Two new workshops are available on "Engaging the Private Sector in Transportation Planning," and "Freight Data Made Simple" and course development is underway for a course on "Freight and the Environment."

The "Talking Freight" Seminar Series via web conference, cosponsored with the Office of Planning, presents and discusses topics relevant to the freight community the third Wednesday of every month from 1:30 – 3:00.

The FHWA Virtual Freight Team (VFT) leverages the technical talents of many of FHWA's Resource Center Technical Service Teams and serves as a resource to develop and deliver freight training and assistance to our customers from a variety of functional areas including safety, finance, operations, planning, air quality, and the environment.

The FHWA Freight Council continues to facilitate information sharing between FHWA units and responds to customers' freight-related needs. Proceedings of the FHWA- and AASHTO-sponsored National Freight Conference on roles and responsibilities of state freight coordinators are available on the Operations Web site at www.ops.fhwa.dot.gov/freight. Addressing the steps identified at the Conference requires continued Freight Council participation and AASHTO involvement.

C. Vehicle Size and Weight

1. Training and Technical Assistance: Program Manager, Julie Strawhorn (Julie.Strawhorn@fhwa.dot.gov)

HOFM will offer two new training opportunities for States, FHWA Division staff, and the public on the various requirements of the Size and Weight program. The first program is a formal classroom course for FHWA Division and State enforcement personnel that provides guidance on how to run an effective size and weight enforcement program. Development of the NHI training course will be completed in 2006. The second program is an on-line training course for the public on various aspects of rules, regulations, and size and weight activities. On-line training is expected to begin in 2007.

2. Electronic Reporting and Access: Program Manager, Julie Strawhorn (Julie.Strawhorn@fhwa.dot.gov)

HOFM is developing an automated system, called the Compliance Web page, that allows FHWA Division Offices and State DOTs to develop and submit required annual Enforcement Plans and Certifications of activities electronically. The system also will include a searchable database of interpretations by subject or regulatory reference.

Anticipated delivery date is Fall 2005. Five States and the District of Columbia participated in the pilot of this program with excellent results. Tutorial and, if needed, field training on the new system will be made available to users.

D. Intermodal Freight Technology: Program Manager, Mike Onder (Michael.Onder@fhwa.dot.gov)

To improve freight mobility and enhance its security, FHWA is pursuing an aggressive intelligent transportation systems (ITS) technologies research program in concert with industry. A recent HOFM report, *The Freight Technology Story*, discusses the results of several FHWA-conducted operational tests, such as the Air Cargo Supply Chain Manifest System, electronic seals, and asset cargo tracking, HOFM is currently involved in an ITS initiative that will build on previous operational tests and will streamline information exchange between supply chain partners. The initiative involves private sector participants and agencies within the Department of Homeland Security. A deployment test is planned to begin in 2006 and be completed by 2007. FHWA is also working with industry through the Intermodal Freight Technology Working Group to identify future projects.

HOFM, in coordination with the Office of Interstate and Border Planning and Transport Canada, are spearheading an effort to develop a border-information flow architecture. The initiative involves numerous stakeholders and is intended to be a framework that depicts the flow of information between government agencies and components of the transportation system, as they relate to border processes (e.g., the flow of advanced traveler information from inspection and enforcement agencies to transportation organizations). The objective is to develop an architecture that promotes information sharing and coordination among agencies and stakeholders and increases the interoperability of technologies used to support their operations. The final product will be completed by December 2005.

VI. IMPROVING MOBILITY AND SECURITY THROUGH BETTER EMERGENCY MANAGEMENT

A. Emergency Transportation Operations

1. Reducing Vulnerability of Agency-Owned Telecommunications system: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

The intelligent infrastructure is a critical resource in managing during a disaster. Just as the vulnerability of traditional transportation infrastructure is being assessed and measures are being taken to reduce its vulnerability, comparable efforts are needed for our electronic infrastructure. This report looked at several existing systems and analyzed what we know about agency-owned telecommunications systems and how they can be made less vulnerable to attack. The report is awaiting approval by agency Counsel for public release.

Reducing Vulnerability of Transportation Management Centers: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

This project is examining the security of transportation management centers and what measures can be taken to reduce their vulnerability. The final report will be available in CY 2005.

3. Emergency Management Integration: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

This project on integration of TMC and emergency management information/systems, jointly managed between the Emergency Transportation Operations and Road Weather programs, is looking at how information can be integrated to support decision-making.
(see #8 under Road Weather Management Program)

4. Communications Interoperability: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

This project is examining the voice communication needs of transportation agencies during emergencies, what technologies are available to provide interoperability, and what initiatives are underway in the public safety community that transportation agencies should participate in so that they are able to interoperate with other responders. The final report will be available in CY 2005.

5. Transportation Emergency Response/Recovery Workshop Followup: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

Having successfully completed the 30 highly popular workshops, a lessons learned and successful practices report is being updated, and sites will be surveyed to determine what progress they have made on the action items they identified. Also, TSA has undertaken an analysis of recurring issues and possible solutions.

6. Alternate Route Development: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

Not all states have well defined processes for identifying alternative routes around critical transportation infrastructure that might be damaged or destroyed. This report is documenting a recommended methodology for developing such routes. The final report is under review.

7. Traffic Signal Timing For Evacuation: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

This study by the University of Maryland is looking at how traffic signals can be timed within a metropolitan area to facilitate evacuation of citizens and response to the scene at the same time. Work is due to be completed in the summer of 2005.

8. Managing Pedestrians in Evacuations: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

This project is examining how pedestrians impact mobility during evacuations and how transportation agencies and their partners can overcome the mobility limitations caused by potential masses of pedestrians in the travel lanes. Work is due to be completed in late 2005.

9. Security Self-Assessment: Operations Lead, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

The Office of Operations is providing operationally focused input to the Security Self-Assessment tool development effort. A draft product, developed with ITE is now available on their security website. The final tool is scheduled for completion in 2005.

10. Security Training Plan: Operations Lead, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

The Office of Operations is providing operationally-oriented input to the development of a training strategy for FHWA personnel involved in transportation security. John Gerner in the Administrator's office manages this effort, being performed by the Volpe Center. The strategy is due to be completed in 2005.

11. Emergency Transportation Operations ITS Initiative: Program Manager, Vince Pearce (Vince.Pearce@fhwa.dot.gov)

The Emergency Transportation Operations Initiative looks at how evacuations resulting from unexpected events can be managed so that they proceed more rapidly and safely. The Initiative plans to provide solutions that will help transportation management centers to understand evacuation conditions and take actions across all modes to facilitate their progress, working jointly with public safety, public safety, and security agencies.

B. FHWA Emergency Operations

1. Military Coordination Exercises: Program Manager, Dan Ferezan (Dan.Ferezan@fhwa.dot.gov)

FHWA posted "Coordinating Military Deployments on Roads and Highways: a Guide for State and Local Agencies" to the http://www.ops.fhwa.dot.gov/opssecurity/index.htm Web site on 3 June 2005. This document has been under development since 2001. It was produced using lessons learned and best practices obtained from a series of exercise conducted in several states. The objective of the guide is to improve the coordination process required when planning for and conducting convoy operations on roads and highways. The Military Surface Deployment and Distribution Command (SDDC) endorsed the project. A CD version is available by contacting the POC. Printed copies will be available at the end of September 2005.

2. Emergency Preparedness and Response Training: Program Manager, Dan Ferezan (Dan.Ferezan@fhwa.dot.gov)

Emergency Coordinators (EC) representing 28 Division Offices, two Federal Lands Highways offices, a resource center, Turner Fairbanks Highway Research Center, and the National Highway Institute completed annual training by attending one of three eight-hour training sessions conducted in Atlanta; Kansas City, MO; or Portland, OR, in May and June. Training was focused on the changing role of the EC due to changes in the environment created by implementation of the National Response Plan and several other factors. Attendees were nearly unanimous in supporting the need for annual face-to-face training. Planning is underway for 2006 annual training. To further enhance EC readiness a contract is being established to produce a series of Web cast training sessions identified by attendees as requiring additional emphasis. The initial Web cast is expected to be conducted in late September. Headquarters leadership and selected staff members participated in two training exercises designed to test

FHWA capabilities to respond to incidents of national significance and execute continuity of operations plans. Lessons learned from these exercises will be used to revise headquarters plans and will be included in field training.

3. Continuity of Operations (COOP): Program Manager, Dan Ferezan (Dan.Ferezan@fhwa.dot.gov)

A review of office COOP Plans on file at Headquarters, discussions with field ECs, and input received during annual training indicates there is a need to provide assistance to the field on COOP planning to ensure compliance with National policy. Several resources to assist division offices are or will be available. A COOP plan self assessment tool produced by the Federal Emergency Management Agency (FEMA), the Federal Government proponent for COOP planning, has been provided to each EC. In September, TRB is expected to publish a document named Continuity of Operations Plans for Transportation Agencies, a result of a National Cooperative Highway Research program project. Headquarters has been involved with the review of several iterations and the final draft of the document. The headquarters COOP Program Manager is available to conduct COOP planning assistance visits at division offices provided travel funds are available. Offices desiring assistance can contact Dan Ferezan, 202-366-4628.

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